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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Automobile Injuries—*Kazanjian*
Dental Caries—*Bunting*
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Spring Lock and Extension Bridge—*Neuroh*
Malocclusion and Retention—*Schlosser*
Postgraduate Orthodontia—*Jones*
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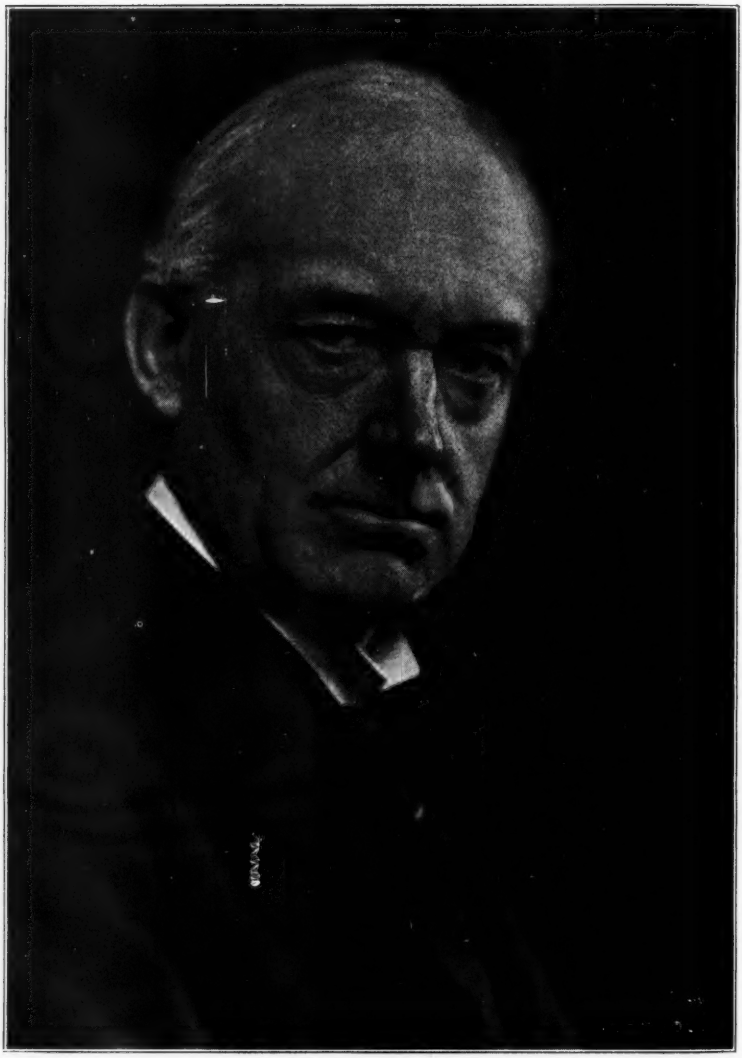

RT. HON. LORD RIDDELL
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Original Communications

TREATMENT OF AUTOMOBILE INJURIES OF THE FACE AND JAWS*

By V. H. KAZANJIAN, C.M.G., D.M.D., M.D., F.A.C.S., Boston, Mass.

DURING the past twenty years, there has been a marked increase in the number and the severity of traumatic injuries of the face and jaws. In former times, facial injuries requiring the services of the oral surgeon were usually mild, consisting mostly of fractures of the mandible and occasionally of the maxilla. Today, the picture is entirely changed, probably owing to the fact that this is a machine age. We are constantly confronted with serious injuries, often presenting a complicated picture from the surgical point of view. With the increase in the use of machinery in factory employment, and also in the use of the automobile and railroad for transportation, to say nothing of airplane travel, we see each year a greater number of accidents; and while injuries to the face may form only a small percentage of these casualties, they assume importance because there are many vital organs within the skull. Moreover, a deformity of the face makes the patient more conspicuous, causing him mental as well as physical discomfort.

*Read before the American Society of Oral Surgeons and Exodontists, Buffalo, N. Y., Sept. 10, 1932.

THE NATURE OF INJURIES

Traumatic injuries of the face may be limited to either the soft tissues or the bony structure, or may involve both. In superficial wounds, one often sees cuts and contusions or deep multiple lacerations involving the muscles of mastication and speech or the branches of the facial nerves. It is not uncommon to see permanent injuries to the eye or the loss of part of the nose or lips. A few years ago, I was called to a neighboring state to see a patient who, while repairing some machinery, had been injured by a flying tool, which struck him across the bridge of the nose. The blow instantly caused loss of sight in both eyes as well as a massive fracture of the bones of the upper part of the face. Curiously enough, there was

scarcely any evidence of injury except swelling and edema.

INJURIES TO THE FACIAL BONES

In most accidents, the bony structure as well as the soft tissues of the face is involved. Fractures involving the nasal, malar, maxillary and mandibular bones are seen, usually multiple, though sometimes compound or comminuted. Occasionally, in extreme cases, the entire facial substructure is so distorted that a permanent change of facial outline results. The following case will illustrate the condition.

Fig. 1.—Appearance of patient before accident.

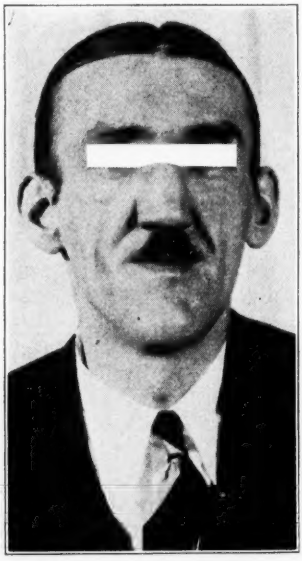

Fig. 2.—Appearance of patient after accident. There is extreme distortion of the upper teeth and upper half of the face.

A young man, while driving an automobile, crashed into a train at an unprotected crossing. His injuries were extensive. I saw him nearly six months later. Examination revealed an old fracture of the nasal, malar and maxillary bones. The upper part of the face was greatly distorted, and there was a pronounced deviation of the septum and nasal bones to the right. The upper and lower teeth did not meet, the upper being pushed backward. The whole facial appearance was much altered, to judge from former photographs. (Figs. 1-2.)

In this type of case, it is obvious, then, that we must keep in mind the entire anatomic structure of the face. Because of the prominence of superficial injuries, it is not unusual to find that the fractures of different bones have been overlooked, especially if the malar and nasal bones are involved. Often inflammation and edema of the face conceal displacements which are not recognized until the chance of establishing immediate corrective measures has been lost.

It is true that the treatment of certain types of face injuries does not properly be-

long to the oral surgeon. If the patient has received lacerations of the soft tissues of the face, a general surgeon will of course, be called to suture the wounds. If there is a fracture of the base of the skull or of the nose, an oral surgeon should not be asked to assume the entire responsibility. The complex injuries involving various parts of the face require the services of several specialists, and the oral surgeon must have sufficient fundamental knowledge to coordinate his treatment with that of the other specialists.

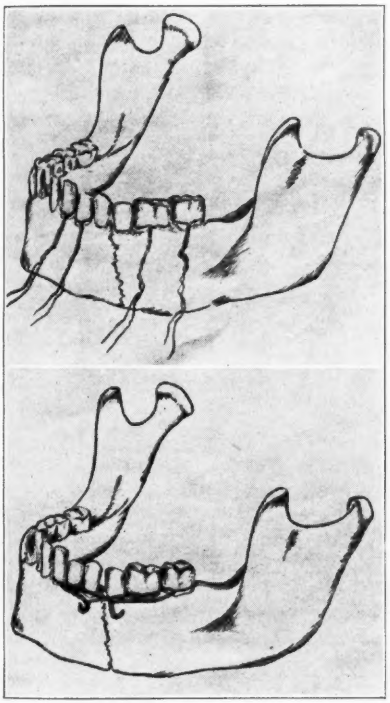

Fig. 3.—Above, brass wires twisted around necks of teeth preparatory to immobilization; below, wires fastened in place to immobilize two segments of fracture.

I should like to emphasize chiefly the importance of a thorough examination in all cases of traumatic injuries of the face. Careful reading of the hospital records, including history, temperature chart and the report of the physical examination by the internist, will make for greater competence on the part of the surgeon. It is important to know whether the patient has been unconscious, and if so, for how long; whether there was any hemorrhage

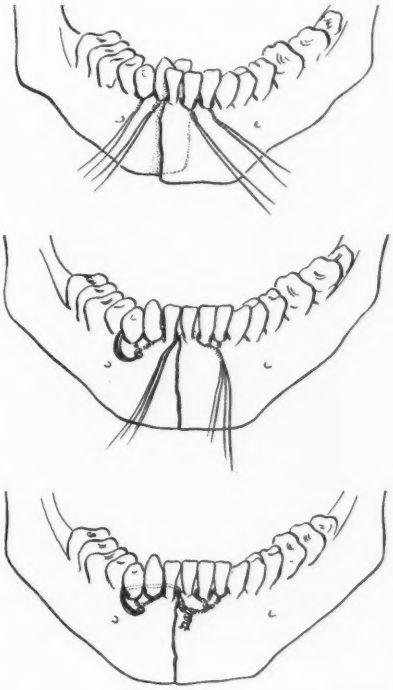

Fig. 4.—Different stages of wiring. The brass wire is twisted around selected teeth and paired. The wire on the side which is displaced backward is passed through the distal side of the bicuspid, follows the lingual surfaces of the teeth toward the median line and is brought out again approximally from the tooth. The purpose is to bring forward the overlapping edge of the displaced segment.

from the nose, mouth or ears immediately after the injury; what the blood pressure has been, and whether the patient was in shock for a long time. In addition, we should check up on the temperature and the pulse count, especially to inquire whether the latter is abnormally slow or accelerated in relation to the temperature. These are all questions the answers to which will throw much light on the condition as a whole.

Fig. 5.—Wire hooks around necks of selected upper and lower teeth in fracture case with open bite. Intermaxillary elastics reduced the displacement within a few hours.

For instance, loss of consciousness following accidents is not uncommon, but if there has been bleeding from the ears and nose, and if examination reveals multiple fractures of the maxillae and the nasal and malar bones, we may suspect the presence of a fracture also of the base of the skull. A low pulse count, say between fifty and sixty, may be a symptom of cerebral pressure, and if the patient has been having severe headache, projectile vomiting, restlessness and other neurologic symptoms, much greater concern is occasioned.

Another example: Most patients with multiple injuries of the face and jaws will suffer swelling and edema of the face within twenty-four hours. It is important to know whether the inflammation is

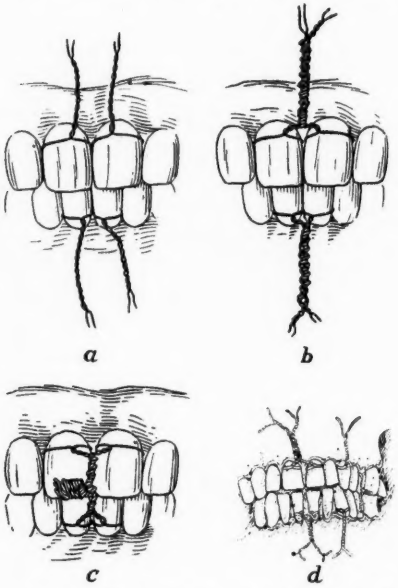

Fig. 6.—Wires passed and twisted around necks of different teeth and upper and lower teeth, then fastened together. Bicuspids and molars are wired singly, but incisors and cuspids should be fastened together in pairs, as in the diagram, then attached to the corresponding teeth of the opposite jaw.

increasing or gradually receding. The temperature chart, the white blood count, the nature of the swelling, the general appearance and the behavior of the patient are our guides, and the future course in the treatment is influenced by the find-

ings, as the first effort must be to combat the spread of infection.

MANDIBULAR FRACTURES

At this point, certain important diagnostic signs in injuries of different parts of the face should be emphasized. The detailed diagnosis of fractures of the mandible is unnecessary before this body of surgeons. Roentgen-ray combined with clinical findings, such as the disturbance of normal occlusion, the displacement of fragments and the inability of the patient to masticate, are the main

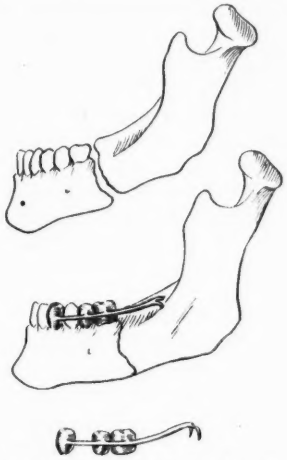

Fig. 7.—Splint especially designed to prevent displacement of distal segment.

points to be considered. In examining actured mandibles, let us not forget that partially fractured teeth and missing teeth may be driven into the socket or imbedded in the soft tissues of the mouth. Thus, they may become important as foreign bodies or foci of infection in later complications.

Maxillary fractures may show little displacement, but, in severe cases, when the fracture line extends to the orbital plates, displacement may be not only downward but also backward, and there may even be a twisting laterally. Moreover, if the nasal bones are involved, backward displacement may be more marked toward the base of the skull than farther down toward the occlusal surface. As can be readily understood, the mode of treatment depends on correct diagnosis.

Diagnosis of fractures of the nasal bones should not be difficult, but certain conditions often mislead the operator, especially in simple cases. After injury, the soft tissues often become swollen and

Fig. 8.—Splint in position in Case 1.

edematous, and, as a result, the distortion of the nasal bones is not evident. Nasal fractures, if not badly comminuted, heal rapidly. Therefore they should be reduced within a few days to avoid deformity and a secondary corrective operation later.

A patient may suffer from various types of nasal fractures: 1. In the most common type, one nasal bone is displaced inward. 2. The nasal arch is displaced laterally. 3. The nasal bones including

the maxillary processes, are flattened. 4. The septum is displaced.

Change in the normal contour of the face is a major point in diagnosing fracture of the nasal bones; but since these bones are either bent to one side or depressed, and since edema and swelling of the soft tissues are frequently marked, it is not always possible to rely on this symptom. We must also determine the degree of mobility of the nasal bones manually, and usually must resort to roentgen-ray pictures.

Fracture of the malar bones, singly or in association with fracture of the maxillae, is common and failure to diagnose this type of fracture sometimes leads to marked disfigurement. The most common of malar bone fractures is the inward

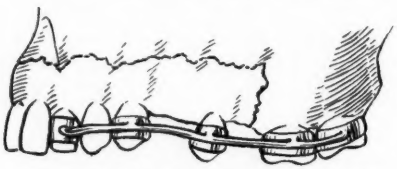

Fig. 9.—Partial fracture of upper jaw. The displaced fragment is held in position with a band and wire splint.

and downward displacement of the zygomatic prominence. In this type, there is separation at the suture line of the infra-orbital ridge. Also, the zygomatic process may be fractured, the two halves being pushed inward toward the coronoid process and assuming an angular form. Occasionally, there is comminution of not only the malar but also the entire infra-orbital plate and external wall of the antrum.

The outstanding diagnostic points are: (1) depression of the zygomatic prominence; (2) disturbance of the contour of the infra-orbital ridge; (3) anesthesia of the skin in the area supplied by the infra-orbital nerve; (4) if the zygomatic arch is depressed toward the coronoid process of the mandible, partial ankylosis of the mandible; (5) roentgen-ray appearance, and (6) an occasional conjunctival hemorrhage and ecchymosis about the orbit.

TREATMENT

In the treatment of face and jaw injuries, it is first of all imperative to take measures to prevent infection of the injured parts. If the wounds are already infected, as most face wounds are, more or less, an effort must be made to keep the infection under control and localized. Preventive measures consist mainly of (1) making the patient comfortable (minimizing the pain to assure as much rest as possible); (2) if there are deep lacerations, adequate drainage; and (3) adequate surgical attention as regards foreign bodies, broken down teeth and comminuted alveolar processes and teeth along the line of fracture, as soon as the condition of the patient permits.

TREATMENT OF INJURIES OF THE SOFT TISSUES OF THE FACE

To assure rapid healing, with a minimum amount of scar formation, injuries to the soft parts of the face should receive immediate surgical attention. Lacerated tissues should be carefully sutured, with the following precautions: 1. A search should be made for foreign bodies. 2. The jagged borders of the wound should be excised to create a smooth surface for approximation and suturing. This procedure is not always practiced, and, as a result, unsightly scars are frequently seen. Wounds of the face readily become septic, and uneven surfaces, if brought together, though they heal by first intention show varying degrees of inflammatory reaction. The obvious objection to excision is loss of tissue, but this does not interfere with

proper approximation, as the tissues of the face are loose and can readily afford the slight loss. 3. In suturing, the borders should approximate accurately, special attention being given to the eyelids, borders of the lips and alae of the nose. 4. No undue tension should be applied to sutures. 5. Sutures should be removed in from three to four days. 6. If the tissues are greatly inflamed when

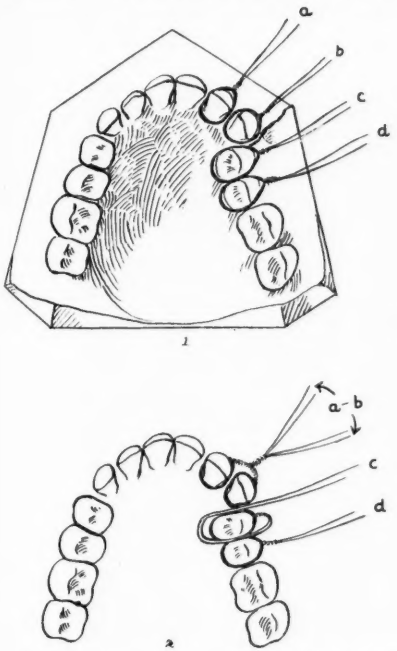

Fig. 10.—Inward displacement in partial fracture of maxilla corrected by wires. (Compare Fig. 11.)

first seen, it may be necessary to apply hot fomentations for a few days, late primary suturing being carried out within four or five days. Potentially infected wounds should not be closed and drainage should always be allowed. 7. In injuries affecting the eyelid and nasal and oral cavities, suturing of the mucous membrane surfaces should receive as careful attention as that of the skin surfaces. The deep muscles of the face, the major branches of the facial nerves or the parotid ducts, if severed, should receive consideration and should be sutured if necessary.

In spite of careful treatment, face wounds occasionally leave conspicuous scars, and patients unjustly blame the surgeon. There are certain factors in the healing of wounds over which we

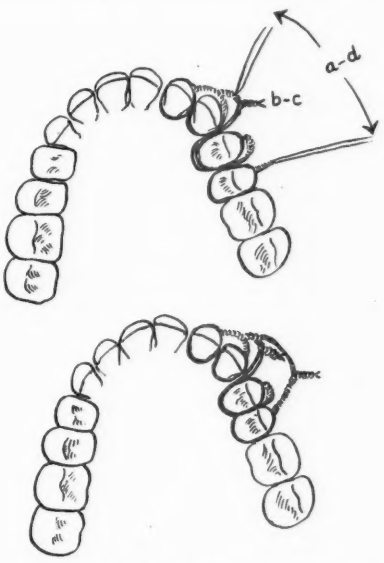

Fig. 11.—One of distal wires passed around bicuspid to bring forward displaced part when connected with opposite side.

have no control. All else being equal, a clean wound will leave less scar than an infected one. As all face wounds are potentially infected, the general physical condition and resistance to infection play an important part. The location and direction of the wound also affects scar formation. Wounds of the forehead, eyelids and nose leave less conspicuous

scars than do those on the cheek and lips. In some patients, any lacerated tissue will show a strong tendency toward keloid formation, and little can be done to allay this process. It is not surprising, therefore, that many patients need secondary operations for the removal of scars.

TREATMENT OF INJURIES OF THE FACIAL BONES

In the treatment of bone injuries, the aim is to (1) restore the normal contour of the face by placing the distorted bones in correct anatomic position, and immobilizing them; (2) restore normal function of the different parts, such as the nasal passages and organs of mastication, and (3) treat deep infections which are likely to involve the different sinuses. It is imperative that immobilization of bones be accomplished as soon as possible, for, in the early stages of the condition, the technic is simpler and the results are more satisfactory. A delay may cause not only secondary infection and destruction of bone, but also permanent deformity and impairment of function.

In combined injury of the soft parts, as well as of the body structures, or even in deep lacerations, procedure should be modified according to the degree of comminution of bone and the resulting sepsis. Wounds should not be closed unless adequate drainage is established for the evacuation of septic discharge. On the whole, closed wounds are more troublesome and more serious than open ones, and much damage has been done by the hasty suturing of wounds in such cases.

Fig. 12.—Barton bandage plus elastic bands on either side of face to effect continuous pressure.

It is not my intention to discuss in

detail the problems associated with immobilization in fracture of the maxilla and mandible, but to suggest a few emergency measures that are easily carried out at the bedside or in the operating room shortly after the injury has occurred.

In fractures of the body of the mandible, when there are sound teeth on either side of the line of fracture, it is comparatively easy to utilize the existing teeth by passing wires around the necks of certain teeth, and connecting them across the fracture line. This method with various modifications has been most satisfactory in recent fractures

Fig. 13.—Massive fracture of upper jaw with downward displacement of maxilla (corrected by an external elastic bandage [Case 2]).

where segments could be manipulated easily into position and there were the necessary teeth present. (Figs. 3-4.) In case there is difficulty in bringing the fragments into alinement, in addition to wiring, one can make wire hooks around the necks of selected teeth in the upper and lower jaw and apply elastics from maxilla to mandible to maintain the displacement to normal occlusion. Later, this method can be supplemented with the use of more positive splints. (Fig. 5.)

In fractures involving the ramus in those persons who have not teeth available for use in anchorage on one side, we are obliged to use interdental wiring, such as is commonly used. Here again, if displacement cannot be reduced easily, it is better to resort to slow reduction by elastic pressure. In using elastic bands, we must guard against undue and prolonged tension on the incisors as they are most easily loosened in the socket. This weakness is partly offset if the teeth are paired in wiring as seen in Figure 6.

I have always been reluctant to wire the maxilla and mandible together in-

Fig. 14.—Appearance of patient on discharge from hospital (Case 2).

discriminately, because, first, it is not necessary in most cases involving the body of the mandible, as it subjects the patient to unnecessary discomfort, and because I consider that the ideal immobilization consists of control of the fragments with such devices as will allow the parts to function as well as possible. For this purpose, I advocate the use of retention splints, whenever circumstances permit. Objections to this procedure have been made on the grounds that the use of dental splints requires the services of a skilled mechanic.

To my mind, this objection has no sound basis, for, at the present time, there is a variety of manufactured bands on the market which can be utilized, and, with a simple laboratory technic, a splint is produced in a short time.

As you know, it is often difficult to control the posterior fragment in a mandibular fracture behind the molar area, especially if splinting is delayed. It is much easier to prevent such displacement if treatment immediately followed the injury.

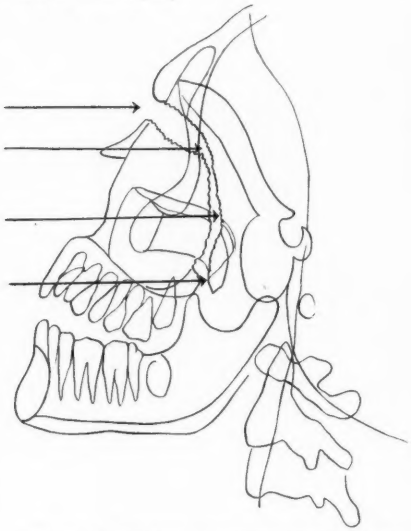

Fig. 15.—Tracing of roentgenogram showing lines of fracture of maxilla (Case 3).

If the operator prefers to wire maxilla to mandible, a well-shaped dental compound biteplate to fit over the alveolar process can be applied successfully until a more positive method is possible.

I have used quite successfully in such fractures a splint consisting of two or three bands fitted over selected teeth. These bands are joined with a No. 16 wire which has a prong at the extended end. This prong, in turn, is fitted to the upper surface of the posterior fragment. The prong causes but little irritation to the soft tissues and it is an effective agent for preventing upward displacement of the fragment. (Fig. 7.)

Case 1.—G. S. received a blow on the jaw, July 3. Examination, July 11, revealed a fracture of the lower jaw in the right molar region, the root of the molar in the line of fracture. There was no displacement of the fragment. July 12, the root was removed under local anesthesia, and impressions were taken for the construction of a splint. The splint was cemented over the teeth, July 14, the splint having an extension prong to hold the posterior fragment in position. July 15, under local anesthesia, the gum was incised, the bone exposed and the prong of the splint pressed against the alveolar process of the distal fragment. The patient made an uneventful recovery, with the jaw completely consolidated. He was discharged and the splint was removed later by his local dentist. (Fig. 8.)

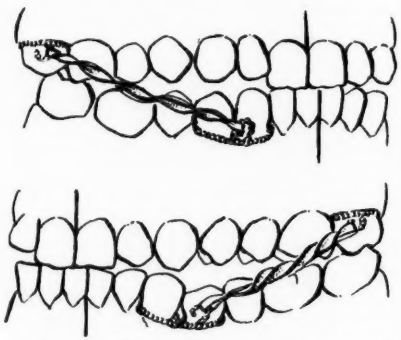

Fig. 16.—Displacement of upper teeth following fracture of maxilla, corrected by use of elastics.

In partial fractures of the maxilla involving the alveolar processes, immobilization is readily obtained by using retention splints (Fig. 9), and in favorable cases, one can even readily utilize the method of wiring seen in Figures 10-11.

In complete fractures involving the entire upper jaw, immobilization is carried out in accordance with the de-

gree and type of displacement. If the displacement is mainly downward and the occlusion of the teeth is not disturbed, a pressure bandage is effective, provided there is no laceration or inflammation under the chin or about the face. The so-called ace bandage, which has considerable elasticity and exerts the necessary upward pressure, can be used, or an ordinary surgical bandage can be readily applied, in the following manner: First, a Barton bandage is applied, and about the face a few ordinary elastic bands are stretched on each side in front of the ears. These elastics are retained in position with adhesive tape. (Fig. 12.) These may be adjusted at will to regulate the upward pressure necessary to immobilize the part.

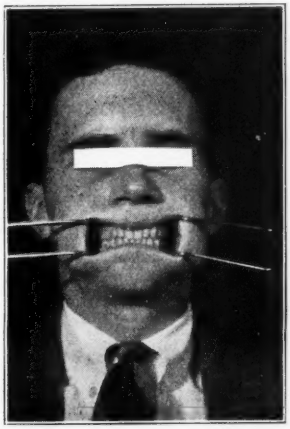

Fig. 17.—Occlusion of teeth after application of elastics.

CASE 2.—M. G. P. was admitted to the Massachusetts General Hospital after an automobile accident. Examination revealed that the soft tissues of the face and lips were swollen and there were a few contusions about the face, but no deep lacerations. There was a massive fracture of the bones of the upper half of the face, including the maxilla. The line of separation extended toward the frontal eminences diagonally downward and backward toward the pterygoid plates. Downward displacement was so marked that upward pressure against the upper front teeth lifted the upper jaw about 1 cm. There was no disturbance of normal occlusion when the upper and lower teeth came together. Therefore, as soon as the inflammation of the soft tissues began to subside, an elastic bandage was made in order to effect pressure upward. Within three weeks, the patient was discharged from the hospital and the external bandage was discarded. (Figs. 13-14.)

Extensive maxillary fractures associated with pronounced downward and backward displacement of the maxillary bones and involving the nasal and malar bones are naturally serious. Often, the physical condition of the patient does not permit of measures which are considered essential if subsequent deformity is to be prevented. Simple methods of gradual reduction of the distorted bony fragments are possible, often without the aid of general anesthesia. In such cases, my first effort is to use methods that will overcome the anterior-posterior displacement; the second, to overcome displacement downward.

Fig. 18.—Appearance of patient after accident (Case 4).

For the reduction of the anterior-posterior displacement, intermaxillary

elastics are used. Wire hooks are placed around selected teeth, usually the last teeth in the upper jaw, and cuspids or incisors on the lower jaw, and elastic bands are applied to these hooks. It is not necessary to use a great deal of elastic force to overcome displacement in recent cases. In fact, the patient is scarcely conscious of the constant tension of the elastics, yet results are surprisingly good. Often, we find that within twenty-four hours the occlusion of the teeth has become normal.

The next step is to overcome the

Fig. 19.—Backward displacement and comminution of maxilla (Case 4).

downward displacement. For this purpose, it is necessary to make a headgear, fitted over the top of the head and forehead, to act as a point of anchorage. This headgear may be made of surgical strapping material, plastic bandage or guttapercha, the choice depending on the facilities at hand and the nature of the injury.

Having the above-described external appliance ready, we have the choice of two methods of immobilization of the jaw. The first consists in constructing an intra-oral splint, which is fastened over the upper teeth with arms extending from the corners of the mouth parallel to the side of the face, similar to Kingsley's appliance, and with elastics extending from the appliance to the headgear. The second method consists in forcing the lower jaw against the upper by means of a chin-piece or intra-oral appliance fastened to the lower jaw. On the whole, the latter method, that

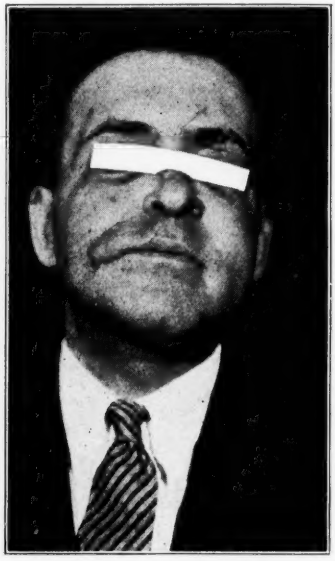

Fig. 20.—Appearance of patient at time of discharge from hospital (Case 4).

is, forcing the lower jaw against the upper, is more desirable in many cases, because, with this method, one is able to maintain the occlusal relation of the teeth.

Let me repeat: Deformities following multiple fractures of facial bones are most often due to failure of the operator to intervene promptly. They involve the bones of the upper half of the face rather than the lower. These bones should be immobilized early.

CASE 3.—L. W., a youth, aged 19, admitted to the Worcester City Hospital, Nov. 26, 1931, after an automobile accident, was in a slight degree of shock but was not unconscious. There was a deep laceration of the scalp over the left eyebrow and nose; a comminuted fracture of the maxillary, nasal and malar bones, and a fracture of the superciliary arch of the frontal bones. There was quite free bleeding from the nose and mouth and hematoma of both eyes. The mind was clear. The lacerated tissues were sutured in the accident ward and the patient was treated for shock.

I saw the patient, December 4, eight days after the accident. The superficial wounds had already healed, but the face was considerably swollen. The nasal bones were deviated to the left and there was a definite depression at the right infraorbital ridge.

Fig. 21.—Double fracture in edentulous patient (Case 5), with pronounced backward displacement and overriding of right side of mandible.

The entire upper jaw, including nasal and malar bones, was pushed downward and backward, and twisted slightly to the right. (Fig. 15.) The occlusion of the teeth was as seen in Figure 16. There was a slow pulse, ranging from 56 to 70, but there were no neurologic symptoms. The general physical condition was good. The patient was transferred to Phillips House of the Massachusetts General Hospital, December 4. Soon after his arrival at Phillips House, wire hooks were made over the upper right and left first molars, and lower right and left bicuspids and cuspids, and intermaxillary elastics applied. In the meantime, external pressure bandages were used to reflect pressure against the upper jaw. Within two days, the occlusion of the teeth became normal, although there was considerable mobility of the maxilla.

The pulse became slower and swelling appeared over the eyebrows and forehead. A lumbar puncture was made and the patient examined neurologically, but no symptoms were found to suggest cranial pressure or meningitis. The nasal mucous membrane was cocainized three times a day to allow more drainage from the nasal sinuses. This effected

Fig. 22.—Open reduction of fracture (Case 5); twisted end of wire protruding through gum margin.

a discharge of purulent secretions from the right side of the nose and, thereafter, swelling over the eyebrow and forehead gradually disappeared.

December 12, sixteen days after the accident, the nasal and malar fractures were reduced. The patient was discharged from the hospital, December 29. The upper jaw was in complete union and the occlusion of the

teeth normal. There was no appreciable external deformity. (Fig. 17.)

In this case, I wish to emphasize (1) the method of correction of the occlusion, which was done at the bedside; (2) careful examination and expectant treatment in the presence of slowing of the pulse, and (3) the necessity of establishing drainage in the presence of impending infection over the forehead and eyebrows.

CASE 4.—N. P., a man, aged 31, was injured in an automobile accident, Aug. 18, 1929, receiving multiple lacerations, and fractures of the facial bones. He was first treated in a local hospital, where the wounds of the face were sutured. I saw the patient at the Massachusetts Eye and Ear Infirmary, August 21, i.e., three days after the injury. The face was greatly swollen and distorted, the left eye was evidently destroyed and there was no evidence of sight. The ocular contents were disorganized. The vision of the right eye was good, although there was conjunctival hemorrhage. The nose was fractured and bent to the left. The malar bone was fractured and displaced. The upper jaw was fractured in at least three distinct places, with pronounced backward displacement of the segments. The mandible was fractured in the right cuspid region. There were numerous cuts on the face and forehead, several of which were already suppurating freely. The patient had lost a considerable amount of blood and was quite pale. There were no meningeal symptoms, and no great pain. (Figs. 18-19.)

As the face was greatly swollen, the sutures were removed to allow drainage of the suppurating wounds. For a few days, the treatment consisted of warm mouth washes and hot fomentations over the face to localize and reduce the inflammation.

August 27, nine days after the injury, the patient was operated on under general anesthesia. The left eye was enucleated. The loose teeth and loose alveolar processes about the right and left molar regions were removed. The left antrum was exposed through the canine fossa and cleaned of disorganized blood. The displacement of the left malar bone was corrected and the nasal fracture reduced. The median fragment of the maxilla carrying the six anterior teeth was loose and pushed back for a considerable distance. An attempt was made to connect the different fragments of the upper jaw with wires. The lower jaw was immobilized by wiring.

On the following day, an impression of the upper teeth was taken and a metal splint with attachments was made in order to bring the upper jaw forward with the aid of external appliances. This was successful, but the bite was open to a considerable degree. The anterior segment was brought downward into fair position by the use of intermaxillary elastics.

September 5, a few pieces of necrotic bone were removed and the splints readjusted.

September 30, the patient was discharged from the hospital. The intraoral splints were still in position. The nose was in the median line and the face assuming its normal contour. The relation of the upper and lower jaws was not, perhaps, so good as before the accident, but the upper and lower teeth met each other. No attempt was made at this time to excise the scars of the face. (Fig. 20.)

Fractures of the mandible in edentulous patients have certain characteristics which it is well to remember: 1. Patients are almost invariably old, or past middle age. 2. Fractures usually involve both sides, but are simple. 3. Almost always, one of the fractures at least is overriding. 4. There is usually rapid healing unless complicated by infection or osteomyelitis.

In the absence of the teeth, we are obliged to resort to indirect fixation by utilizing the dental plates of the patient or making new occlusion plates to fit the intermaxillary space, depending on external pressure of bandages to hold the parts in comparative immobility; or to employ direct fixation by exposing the ends of the fractured bone and connecting them with interosseous wires. If the distortion of the fragments is slight, I do not make any effort to correct it, but allow the part to heal. Then, if there is any unusual prominence over the alveolar ridge after consolidation, it is reduced by a minor surgical operation.

When overriding of fragments is more pronounced, I resort to direct wiring of the parts.

CASE 5.—P. D., a physician, aged 34, re-

ceived a double fracture of the lower jaw and lacerations of the face, in an automobile accident. He was treated in a local hospital in the state where the accident occurred. As he was edentulous, his upper and lower dentures were utilized, by the attending oral surgeon, as a splint. This procedure was supplemented by the use of an external pressure bandage. I saw the patient at the N. E. Deaconess Hospital, December 12, six days after the accident. He was tired from the journey and was suffering considerable pain about the mouth. The lips were badly swollen.

On removal of the pressure bandage and dental splint, it was found that, in the attempt to reduce the fracture of the lower jaw, the rims of the lower denture were pressing into the alveolar ridges, causing considerable pain and laceration of the mucosa. Further examination revealed a double fracture of the mandible involving the right and left molar regions. On the right side, the line of fracture extended obliquely downward and backward with considerable overlapping of the ends. (Fig. 21.) The splints were discarded and mouth irrigations prescribed to reduce the local irritation and soreness of the mouth caused by the splint.

December 18, one week later, under general anesthesia, the fractured right mandible was wired. The operation consisted of making an incision along the right lower alveolar ridge. The two ends of the broken bony parts were separated from the area of soft tissue adhesions. With a hand drill, two holes were made at the end of each stump. A heavy 18-gage wire was passed through the hole and twisted together in a manner to bring the proximal surfaces together. Good approximation was obtained, and the twisted end of the wire was cut so that one part of it could pass through the mucous membrane. The wound was sutured with chromic catgut and rubber dam drainage was established intraorally. The patient made a normal recovery and was discharged from the hospital, January 4.

January 14, the wires were removed. The functional results were very good.

In using artificial dentures as splints in fractures, it is necessary to modify the base of the lower denture to meet the existing condition. As it is next to impossible for the bones to conform themselves to the original shape of the denture even if they are not markedly displaced, it is advisable to trim the borders of the lower denture and reline them with some black guttapercha or dental composition. Failure to do this will cause a good deal of unnecessary suffering to the patient.

As you know, the accepted manner of direct wiring of the mandibular bone as described in textbooks, calls for an external opening. I have found it much easier and simpler to make an exposure of a fractured end through the mouth as described in this case. The operation is followed by surprisingly little inflammatory reaction; which is mainly due to the fact that the parts are not traumatized so much as if we had operated externally. Moreover, the wires protrude through the mucous membrane; which affords considerable drainage. (Fig. 22.)

TREATMENT OF COMPLICATIONS

In the course of treatment of severe injuries of the face, a great many difficult problems are met, but the complication which stands out preeminently and requires constant attention is infection, manifesting itself by cellulitis, abscess formation, osteomyelitis or necrosis.

All face and jaw wounds are potentially infected. In favorable conditions, inflammatory reaction of the tissues gradually subsides, but persistent and increasing inflammation with high temperature, etc., is attributable to lack of adequate drainage. I have stated before that infected wounds should not be closed unless adequate drainage is provided. To ignore this simple rule may involve serious complications.

Often, infection may have penetrated into the deeper tissues and will take its course whether or not wounds are sutured under such conditions. The obvious course is to apply hot fomen-

tations and employ mouth irrigations in order to localize the inflammation and bring the abscess to the surface.

DISCUSSION

A. E. Smith, Los Angeles, Calif.: Unfortunately, most cases demanding reconstructive work in plastic oral surgery fall into the hands of the general practitioner of medicine or even those of the general surgeon. All cases of facial injuries should be in the hands of the specialist in that branch of work. I agree that thorough diagnosis should be made before operative procedure is undertaken. Recently, I was called into a case and the medical man in charge was very much vexed because I did not go into the operating room immediately and perform an operation on a girl, aged 17, who had been injured in an automobile accident. No roentgenograms had been taken and I insisted that some be made. They revealed a fracture of the middle fossa of the skull and fracture of the cervical vertebra. The entire upper jaw was mutilated and fractured, and there was a compound fracture of the lower jaw. I insisted that a brain specialist be called in the case, and he was. Operation was not performed, very much against the wishes of the general surgeon. The patient died the following day. I certainly believe that in every one of these cases a thorough physical as well as a roentgen-ray examination should be made. In traumatic lesions of the face, not only should function be restored, but in addition the appearance is to be considered. Dr. Kazanjian has stressed the question of diagnosis in correction of bone lesions or fractures, to restore the tissues as nearly to normalcy as possible so that plastic procedures can be carried out more easily at a later date. I believe in intermaxillary wiring of the jaws. I should like to ask Dr. Kazanjian why he prefers some of the appliances that he has shown in preference to the intermaxillary wires because I feel that, in these cases, we get so much better occlusion with these wires. I know, of course, that every case is in a class by itself, and I am sure that Dr. Kazanjian has reasons for using the appliances that he prefers to the intermaxillary wires.

A. B. Vastine, Danville, Pa.: There are certain fractures of the maxilla and, rarely, of the mandible, but especially of the neck of the condyle, in which excellent results are obtained by merely manipulating the fractured parts, bringing them into place and leaving nature to do the rest. In some instances, the results are most surprising. We must not only make a physical examination but also inquire into the habits of the patient. In a simple fracture of the jaw, everything was going well, but on the third day, I was called to the hospital. A glance sufficed to reveal that the man was going into the first stage of delirium tremens. The usual treatment was prescribed and when I came back a little later, he had been removed to the operating room, where he died of delirium tremens.

Dr. Kazanjian: I experience failures and meet complications and difficulties. I have learned to try simple methods to accomplish results; to exert the patient as little as possible and, above all, to try to control infection by establishing adequate drainage. Dr. Smith talked of specialists. Of course, the ideal thing would be to have everything specialized, and each patient placed in proper hands, but it is economically not possible. If an accident occurs in a small town, the injured have to be taken care of, and the best we can do is to establish some fundamental rules that every physician and interne could follow. Later on, a specialist could be called in. I am not opposed to maxillary wiring: it has its own place. I am opposed to wiring jaws together where retentional springs could be utilized; for, by this means, we can keep the jaws free. The patient suffers less, and it is not necessary to have the jaws tied together for from five weeks to two months. As regards fractures of the neck of the condyle, I do not know whether by manipulation Dr. Vastine meant external manipulation or surgical manipulation of the neck of the condyle. Two or three years ago, methods were advocated by several men of going through the mouth and reducing the fracture of the neck of the condyle. Previous to that time, good results were obtained by simply wiring the jaws together in normal occlusion and letting the part heal. It did not matter whether the condyle was in proper position or not. In order to give the method a full trial, I tried it in three or four cases, and every one of them was a failure. First of all, I could not correct the displacement by the blind method of touching. I conscientiously tried that and, in one case, displacement was so bad that the condyle was really pushed out of position and inward toward the median line, and I was obliged to expose the socket by external manipulation, and even then I

had the hardest time to bring the condyle into position. I am disappointed in the results of surgical manipulation of the condyles. A good result is attainable by wiring the jaws to normal position and letting the parts heal.

FACTS AND FALLACIES IN OUR CONCEPT OF DENTAL CARIES*

By RUSSELL W. BUNTING, D.D.Sc., Ann Arbor, Mich.

THROUGHOUT the history of the study of dental caries, blind allegiance to misconceptions and erroneous conclusions has greatly interfered with a true understanding of the problem and has delayed its solution. These concepts and conclusions, based largely on hypothetical and *a priori* reasoning, have not been supported by adequate scientific experimentation or clinical observations. Still, these hypotheses have persisted, year after year, often in spite of incontrovertible evidence to the contrary, and have been stated as accepted facts by many writers and students of the problem. New experimental data which have appeared from time to time, valuable additions to the knowledge of the subject, have been twisted in their interpretations to fit the old erroneous idea; while the more logical and valid application has been wholly disregarded.

Fortunately, as the result of recent investigations, scientific data of considerable weight have been obtained which definitely negate certain of the older views and eliminate them from their former position of major consideration. The problem has thereby been greatly clarified and the field of study has been narrowed down to a consideration of what now appears to be the more important factors in the process of dental caries. Even so, the problem is extremely complicated and involved, and unless the fundamental principles concerned are established and accepted as a basis of fact and future studies are built upon them, no progress toward the solution of the problem can be made. Following is a discussion of certain of the fallacies and facts which have appeared in the study of dental caries.

THE INFLUENCE OF THE STRENGTH AND RESISTANCE OF THE TOOTH IN DETERMINING SUSCEPTIBILITY TO DENTAL CARIES

In the early days, considerable opposition was aroused to the millerian hypothesis, and its universal acceptance was long delayed by those who, refusing to accept the germ theory of disease, tenaciously clung to the old humoralistic concept. To them, all disease was due to a disturbance of the blood and lymph circulations of the tissues affected. As to caries of the tooth, they believed that the enamel and dentin were subject to inflammatory changes and that the dental tissues were broken down by a gangrenous process to form a cavity—the old idea of internal caries. When

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at length it was indubitably proved that the enamel and dentin do not possess blood and lymph circulations comparable to those of other tissues of the body, the inflammationist's theory died, but the idea persists even to this day in another form. The proponents of this view accept the hypothesis of Miller, to a degree, but they place the greatest emphasis on the quality of the tooth itself as a determinant of dental caries. Although they admit that the carious lesion is produced by acids, locally formed, they assume that the forces for acid production are uniformly present in all mouths and that the occurrence and course of the disease is determined by the quality and resistance of the dental enamel. Since the tooth is so largely composed of calcium and phosphorus salts, they have advocated a fortification of calcium and phosphorus metabolism for the purpose of inhibiting dental caries through the building of highly resistant teeth. All the recent developments of knowledge regarding diet in its relation to dental caries have been interpreted by them in the light of its effect on the quality and the resistance of the teeth against the disease.

If this view were correct, it might reasonably be expected that all poorly formed teeth would be markedly affected by caries, but such is not the case. In hundreds of individuals, it has been observed that teeth having very poor structure, both macroscopically and microscopically, have been retained throughout life with little or no evidence of caries. Conversely, apparently well formed and structurally sound teeth frequently are attacked by extensive caries. It is recognized that, when caries does occur, the poorly formed teeth are more severely and extensively affected than are those better formed, but it is also true that the occurrence of this disease bears no constant relationship to the quality of the teeth.

For many years, May Mellanby has attempted to establish dental hypoplasia as a major determinant of dental caries. She states[1] that she found caries much more frequent in hypoplastic than in normal teeth. This observation does not constitute valid proof or even presumptive evidence that the caries which she observed occurred as the result of dental hypoplasia. It is fully as probable that those individuals who had defective teeth also suffered from disturbances of general metabolism which may have been a much more significant factor in the production of dental caries than was the structure of the teeth. Furthermore, she quotes McGonigle in saying that rachitic children have more dental caries than normal children, but this statement is directly controverted by MacKay and Rose,[2] who report that, in a survey of a group of children having distinctly rachitic histories, they found practically the same degree of dental caries as among a similar group of normal children.

Hess and Abramson[3] state that children who are protected against rickets develop less dental caries than do those unprotected. It must be remembered that these children were receiving adequate, highly protective diets, which undoubtedly influenced the metabolism in many ways other than by their ef-

1. Mellanby, May: Experiments on Dogs, Rabbits and Rats, and Investigations on Man, Which Indicate Power of Certain Food Factors to Prevent and Control Dental Disease. J. A. D. A., 18:1456 (Aug.) 1930.

2. MacKay, Harold, and Rose, S. F.: Caries Liability in Hypoplastic and Rachitic Teeth, Lancet, Dec. 5, 1931.

3. Hess, A. F., and Abramson, H.: Etiology of Dental Caries, D. Cosmos, 73:849-866 (Sept.) 1931.

fect on the teeth. These authors also call attention to the fact that dental caries is rampant in many of the tropical and subtropical countries where rickets is almost unknown and state that "this (geographic) distribution constitutes a strong argument against regarding rickets as the essential etiologic factor in dental caries."

Furthermore, even though rachitic children were somewhat more susceptible to caries than normal nonrachitic individuals (which has not been definitely established), there is at the present time absolutely no proof that this increased susceptibility is due to hypoplastic defects in tooth structure. There are other avenues through which this metabolic disturbance may affect the process of dental caries much more. These will be discussed later in this paper.

The belief that susceptibility to dental caries is determined or largely controlled by the quality or resistance of the tooth is based solely on hypothetical opinion unsupported by scientific experimentation or evidence and is definitely refuted by so great a preponderance of clinical and experimental observations that it can no longer be considered tenable. At the present time, there is practical agreement among the students of the subject that all teeth, irrespective of their quality, are susceptible, in varying degrees, to dental caries and that the forces which determine this disease are resident not in the tooth itself, but in its environment. In the early stages of caries at least, the tooth plays a passive rôle. The rate and extent of the disease depend somewhat on the integrity and quality of the enamel substance, but more on the intensity of the attacking force and the environmental conditions under which it operates. In view of this fact, there is no scientific justification for the admonition, "feed your teeth" as a specific preventive measure against dental caries.

INFLUENCE OF CALCIUM AND PHOSPHORUS AND THE p_H VALUES OF THE SALIVA AND THE BLOOD

The opinion has been commonly held and frequently stated that the calcium and phosphorus content of the blood and saliva may act as a controlling agency in dental caries. Furthermore, the feeding of these elements and the activators of mineral metabolism has been recommended for the control of caries. At first, the objective of such a procedure was to increase the resistance of the tooth against disease. More recently, C. F. Bödecker[4] has described a "dental lymph" passing from the pulp through the dentin to the enamel, which, by reason of its high calcium and phosphorus content, neutralizes the acids of caries and protects the enamel from dissolution. In this manner, he explains the so-called "immunity" of teeth to dental caries.

If this hypothesis were true, it might reasonably be expected that in pulpless teeth in which all possible flow of "dental lymph" has ceased, there would be an increased susceptibility to dental caries. Clinical observations do not support this view. During the past three years, in the dental clinic of the University of Michigan, I have offered a reward of $1 to any student who presented a case of new caries which began after the removal of a dental pulp. Although thousands of patients have passed through this clinic during these years, I have paid out but $3. This does not indicate that the susceptibility of teeth to caries is increased after the defensive

4. Bödecker, C. F.: Nutrition of Dental Tissues, Am. J. Dis. Child., 43:416-425 (Feb.) 1932.

powers of the dental pulp have been definitely and completely abrogated.

A third group of observers have stated that the process of dental caries is controlled by the calcium and phosphorus and the alkaline elements of the saliva, by which the acids of caries are neutralized before they can attack the tooth. This view presupposes that the salivary fluids have ready access to the site of caries activity on the tooth; a conclusion the validity of which has not been established by any experimental observations.

Each of these three points of view is based on the assumption that the calcium and phosphorus content or the alkalinity of the blood or of the saliva is higher in the caries-free than in caries-susceptible individuals. Recently published analysis of the blood and saliva of caries-free and caries-susceptible individuals do not support this assumption.

During the past two years, the Michigan group have been engaged in an intensive study of two carefully selected groups of children, one of which was distinctly free from dental caries and the other extremely susceptible to it.[5] The object of this study was to determine whether there are chemical differences between the saliva and the blood in noncarious and carious cases. It might reasonably be expected that if any of these qualities operated as a controlling influence, there would be differences in the chemical analyses of either the blood or the saliva of these two groups. As a result of carefully made observations which were repeated on the same individuals over a period of several months, it was found that, although certain variations could be detected, there were no constant or correlated differences in calcium, phosphorus or p_H between members of the two groups.

A study was also made[6] of seventy-five school children, from 6 to 17 years of age, over a period of fifteen months. During this time, more than 700 determinations were made of the calcium and phosphorus of their saliva. Daily supplements were made to the diet of some of these children, consisting of milk, tomato juice and viosterol. The data thus obtained showed that no relationship existed between the calcium or phosphorus content of the saliva of these children and the occurrence of dental caries. Furthermore, in those children who received the supplemental diets, there appeared to be a slight decrease in the incidence of dental caries, but there was no concurrent change in the salivary calcium or phosphorus. Somewhat similar studies have been made by Karshan[7] of Columbia and Enright of the Mellon Institute,[8] whose data coincide with the findings of the Michigan group.

These investigations definitely indicate that, whatever controlling influence the saliva may have on dental caries, it is not by virtue of the calcium, phosphorus which it may contain, or its p_H. Furthermore, no differences could be found in the calcium, phosphorus or carbon dioxide combining power of the blood. These observations strongly negate the hypothesis that dental caries is the result of a low calcium or phosphorus content of either the blood or the saliva or is due to a condition of acidosis.

5. To be published.

6. Hubbel, Rebecca, and Bunting, R. W.: To be published.

7. Karshan, Maxwell; Krasnow, Francis, and Krejici, Laura, E.: Study of Blood and Saliva in Relation to Immunity and Susceptibility to Dental Caries, J. D. Res., 11:573 (Aug.) 1931.

8. Enright. J. J.; Friesell, H. E., and Trescher, M. O: J. D. Res., 12:759 (Oct.) 1932.

ROLE PLAYED BY THE ACID-PRODUCING BACTERIA IN THE PRODUCTION OF DENTAL CARIES

W. D. Miller, in his original hypothesis, stated that dental caries is a destruction of the tooth by acids formed locally by certain types of bacteria acting on carbohydrate food materials. Although he sought diligently for some specific type of bacteria which might be most responsible for caries, he failed to find it and came to the conclusion that there is constantly a wide variety of acidogenic bacteria in all mouths, any one of which, he believed, is capable of producing dental caries.

More recently, an English group[9] and Rodriguez[10] demonstrated that, although there are many forms of acidogenic bacteria in every mouth, there are few types which are able to live in their own products; that is, when undergoing acid fermentation of carbohydrates, the majority of oral bacteria soon die in their own acids. Since, for the production of dental caries, it is necessary that a definite acidity be maintained for a considerable period of time, these bacteria cannot be considered very important causative factors in the disease. Only a very few types of oral bacteria are aciduric and of these the most prominent is a group of lactobacilli commonly classified as *B. acidophilus*. These they believed to be the specific etiologic agency in dental caries.

During the past six years, the Michigan group have been studying the relationship of *B. acidophilus* in the mouth to dental caries.[11] Throughout this study, in which thousands of cases of all types have been observed, a remarkable correlation has been found to exist between the degree of activity of this organism in the mouth and the progress of dental caries. In the early work, in which all determinations were made by the qualitative method, *B. acidophilus* was demonstrated in practically 100 per cent of active cases; while, in many of the caries-free individuals, the organism was either entirely absent or, on repeated cultures, appeared only intermittently or sporadically. In many such cases, it was found that when the organism was introduced into the mouth by daily drinking of acidophilus milk, it promptly disappeared. It was also true that, in large numbers of caries-free individuals, *B. acidophilus* could be demonstrated by the qualitative methods. More recently, Mrs. Hadley[12] has developed a quantitative method of estimating the number of acidophilus organisms present in the mouth and, by this means, has demonstrated that, when the organisms are present in caries-free mouths, the degree of their activity is extremely low and the number of organisms present is very small as compared with that in active caries.

Jay and Voorhees[13] have reported, in the monthly examination of children over a period of several months, the observation that in caries-free mouths in which *B. acidophilus* was absent at first and later appeared, dental caries became active after the appearance of the aciduric infection. A similar observation has recently been reported by Enright.[7]

Boyd and Drain[14] quote Roskin in

9. McIntosh, James; James, W. W., and Lazarus-Barlow, P.: Etiology of Dental Caries, Brit. D. J., 43:728 (Aug. 1) 1922.

10. Rodriguez, F. E.: Mil. D. J., 5:199, 1922.

11. Bunting, R. W., et al.: Am. J. Dis. Child., 40:536 (Sept.) 1930.

12. Unpublished data.

13. Jay, Philip, and Voorhees, R. S.: D. Cosmos, 69:977 (Oct.) 1927.

14. Boyd, J. D., and Drain, C. L.: Control of Dental Caries, Am. J. Dis. Child., 38:721 (Oct.) 1929.

saying that there is no difference between the acid potentials of saliva of caries-free and that of caries-susceptible individuals. This statement is based on the fact that samples of salivas to which carbohydrate has been added when incubated uniformly produce sufficient acid to decalcify tooth substance. This procedure is purely a qualitative demonstration of the presence of acid producing bacteria in the mouth and does not indicate their amount or the degree of their activity in the oral cavity. The presence of a very few aciduric organisms in a specimen of saliva, when incubated in the presence of carbohydrates, might produce fully as much acid in time as another specimen containing millions of these organisms. The quantitative method clearly indicates that there is a vast difference between the degree of aciduric infection in mouths of differing caries susceptibility. In fact, there is at the present time no known factor in the caries process which is so closely correlated with the activity of the disease.

The findings of the Michigan group relative to the causative relationship of *B. acidophilus* to dental caries have been corroborated by similar studies of Thompson of Columbia[15] and of Rodriguez[16] and by the recent work of Enright of the Mellon Institute.[7] The great preponderance of evidence which is now at hand in support of the view that acid-producing bacteria and the products of their fermentation are the immediate cause of dental caries has led to an almost unanimous acceptance of the infective theory of this disease. Furthermore, this infection is a specialized type, consisting of aciduric organisms of the *B. acidophilus* group, which, by their characteristic action on carbohydrates, produce sufficient acid to decalcify the tooth, without which dental caries does not occur.

15. Thompson, R.: Aciduric Organisms in Dental Caries, J. Exper. Biol. & Med., 1931, p. 103.

16. Rodriguez, F. E.: Quantitative Incidence of Lactobacillus Acidophilus in the Oral Cavity as a Presumptive Index of Susceptibility to Dental Caries, J. A. D. A., 18:2118 (Nov.) 1931.

DIET AS A FACTOR IN DENTAL CARIES

It has long been believed that the diet plays an important rôle in the process of dental caries. Many theories have been advanced as to the manner of its action but until recently no acceptable hypothesis has been brought forth. The greatest stimulus to the study of this question has arisen as a result of recent developments in the knowledge of nutrition. The observation that, when animals were fed experimentally on nutritionally deficient diets, caries-like lesions appeared in the teeth, was most significant. By many, it was interpreted as a clear indication that dental caries is a nutritional disease; i. e., a local expression of malnutrition.

During the years that have followed the original work of Mellanby, Howe and Grieves, considerable experimentation in man and animals has been carried on, as a result of which definite progress has been made in knowledge of the question. Unfortunately, many conflicting views and unwarranted statements relative to the importance of diet and the manner in which it is related to dental caries have been advanced which have served to confuse the issue and have retarded the ultimate solution of the problem.

Considerable effort has been made to find some particular food element which is most significant in the control of dental caries. Certain observers have stated that calcium and phosphorus are the

most important nutritional factors; others that vitamine D is the most important, and still others that vitamine C plays the most important rôle. The acid-base balance has also been advanced as a controlling principle in dental caries.

Notwithstanding all the research and study which have been devoted to this problem, no conclusive evidence has thus far been presented to warrant the deduction that any one food factor is more important than another in the control of dental caries. There are strong indications that, both in animals and in man, well balanced diets are more conducive to dental health and more inhibitive of dental caries than are those which are nutritionally imperfect or unbalanced. This principle is the one common denominator which can be observed in all the various dietary studies which have thus far been reported. In an analytic study of the various dietetic experiments in which vitamine D or vitamine C or the calcium-phosphorus or the acid-base balance were studied, it will be observed that the greatest success in the control of dental caries was obtained by the feeding of those diets which were most nearly nutritionally adequate, regardless of the particular food combination employed. No other, more specific food relationship has been demonstrated.

As to the manner in which diet influences the progress of dental caries, several different theories have been advanced. By some, it is believed that the greatest effect is its influence on the structure of the tooth. Others believe that the amounts of calcium and phosphorus in the blood and the saliva are the most important consideration, and still others that the acid-base balance of the blood and saliva is the controlling factor. In the light of previously stated facts, none of these theories can be accepted as tenable and, for the present at least, cannot be regarded as of major consideration in the caries process. The problem then is narrowed down to a study of the possible effect of ingestion of certain foods on the environment of the tooth and the activity of the acid-producing bacteria in the mouth.

In this question, two general considerations are involved: 1. What conditions determine the amount and character of the retained foodstuffs (especially the carbohydrates) which remain adherent to the teeth? 2. What metabolic changes determine the character of the salivary fluids and the influence they may have on the growth and activity of the aciduric bacteria in the oral cavity? These two groups of conditions largely determine the nature of the environment of the teeth and the activity of the aciduric infective organisms.

The first group, which determines the relative degree of cleanliness of the mouth, includes the character of the food ingested, the shapes and arrangement of the teeth, the thoroughness of mastication, the physical and chemical properties of the saliva and the personal care of the mouth by the patient. These are the immediate factors in the cleanliness of the mouth and the activity of the infective attacking forces essential to dental caries. These are not the only factors, however; for it is very well known that in many filthy mouths in which considerable food débris is constantly present, there is no dental caries. Conversely, in many mouths that are relatively clean, caries may be very active. Clearly, the determinant condition is something other than relative or actual cleanliness of the teeth. In unclean mouths that are caries-free, *B. acidophilus* is either absent or extremely low in numerical count. Conversely, in clean

mouths in which caries is active, the counts are invariably extremely high. The question is: To what degree does the character of the retained foodstuffs affect the growth of acid-producing bacteria in the mouth?

The second consideration is the effect which diet may exert on dental caries through its relation to those processes of general metabolism which determine the quality and quantity of the salivary and other oral secretions. Concerning the nature of these metabolic processes and the manner in which diet may affect them, we have little accurate information. There is strong evidence that diet does influence dental caries in some way other than through the food débris remaining in contact with the teeth.

In the dietary experiments of Martha Koehne,[17] of the Michigan group, it was observed that when children were fed on adequate, well-balanced low-sugar rations, as a rule, the activity of *B. acidophilus* in the oral cavity was markedly decreased or entirely checked and dental caries was arrested. It is possible that the most marked effect of diet on dental caries is its influence on the metabolic activators, which determines the character of the salivary secretions; which, in turn, may largely determine the character of the local environment of the teeth and its bacteriologic activity.

IMMUNITY AGAINST B. ACIDOPHILUS

In the past, many attempts have been made to demonstrate a bactericidal agency in the saliva which, by its presence, would limit the growth of oral micro-organisms. As yet, no such immunologic principle has been found, but there are strong indications that some form of specific control does exist. As previously stated, *B. acidophilus* cannot be induced to grow in many caries-free mouths even when repeatedly implanted there. In a study of this question, Jay and Crowley,[18] of the Michigan group, have demonstrated that the blood serum of certain caries-free individuals contained agglutinins against *B. acidophilus* which were demonstrable in dilutions as high as 1:640; whereas, in the blood serum of caries-susceptible individuals, these agglutinins were either entirely absent or extremely low. They have also demonstrated that, when the filtrates from growths of *B. acidophilus* are introduced intradermally, definite skin reactions may be produced which, in a high percentage of cases, coincide with the susceptibility of the individual to caries. Whether a definite immunologic principle exists which, by its action, determines the activity of dental caries remains to be demonstrated.

SUMMARY

In the study of dental caries, we are dealing with a disease the like of which does not exist in any other part of the body. It is distinctly an infestation of the mouth by specific types of bacteria, acidogenic and aciduric in nature, which become implanted on the surface of the tooth and, by the acids which they produce, destroy the tooth. These localized disease processes are not in immediate contact with the blood serum or the natural protective forces of the body. Whatever immunologic control the blood may exercise over them must be transmitted through the intermediary of the secretions of the salivary glands or glands of the oral mucosa.

17. Unpublished data.

18. Jay, Philip; Crowley, Mary, and Bunting, R. W.: Preliminary Studies on Immunology of Dental Caries, J. A. D. A., 19:265 (Feb.) 1932; J. D. Res., 12:429-430 (June) 1932.

These organisms do not have a direct pathogenic action on the tooth enamel, but produce their specific effects through their acid fermentation. They are nonpathogenic saprophytes of the oral cavity which, in the early stages of caries at least, have no parasitic action on the tooth itself. They live, rather, as a result of their environment; i. e., the saliva and food débris.

We may logically view the process of dental caries, therefore, as an attack on the tooth by a bacterial agency which is outside the tooth, having no immediate contact with the body protective fluids and controlled only through the oral environment (the saliva and the retained food materials). In the light of this concept of the disease, the search for the means of controlling dental caries must be directed along two general lines of investigation; namely, a study of the saliva and its action on the bacteria of dental caries, and a study of the quality of the foods ingested and the means of diminishing their retention in the oral cavity.

In the study of the saliva, we are led far afield into all those general constitutional conditions which determine its physical and chemical properties. These include heredity, age, bodily health, nutrition, immunologic reactions and, perhaps, other qualities which we do not now understand. The second phase, the question of food retention, involves the physical and chemical qualities of the foods ingested, especially the carbohydrates, and all those prophylactic measures which determine the amount of food material which will constantly remain in contact with tooth tissues. It appears, then, that through chemical, immunologic and dietary studies directed toward a fuller understanding of the salivary principles which control the activity of dental caries, the greatest benefit will come. At the same time, we should not neglect a serious consideration of the more effective local measures, prophylaxis and dietetics, by which the essential conditions of dental disease may be greatly reduced.

CONCLUSIONS

In the light of recent developments, certain truths regarding dental caries have been established and certain former concepts have been discredited. The acceptance of these conclusions will, for many, necessitate a complete reorientation of thought and concept relative to the disease in question. It will serve to harmonize and to correlate the efforts of the various workers in the field of study and will greatly expedite the progress of the investigations. Some of the more outstanding conclusions are as follows:

1. The structure or resistance of the tooth does not determine the occurrence of dental caries. The quality of the tooth may influence the rate of progress of caries, but, as a rule, is not adequate to definitely prevent its occurrence.

2. The relative cleanliness of the mouth does not determine dental caries, but the character of the retained food materials, in any amount, may play an important part in the process.

3. Calcium and phosphorus and p_H determinations of the blood and the saliva show no indication that these exercise any controlling action on the activity of dental caries.

4. The presence or absence or the quantitative amounts of *B. acidophilus* in the mouth are the most consistent correlating factors thus far observed in dental caries. Evidence is now at hand to warrant the assumption that dental caries is a specific bacterial disease and that *B. acidophilus* is the chief etiologic agency.

5. Immunologic reactions against *B. acidophilus* in the blood of caries-free individuals have been demonstrated.

6. The feeding of adequate and well-balanced diets has been shown to reduce the activity of *B. acidophilus* in the mouth and to inhibit the progress of dental caries in a large number of cases.

DISCUSSION

Mark Elliott, Boston, Mass.: Certain investigators have contended that *B. acidophilus* and other aciduric bacteria are the etiologic factors in dental caries. They have isolated the acidophilus bacillus, also cultured it; but when they have tried to reproduce the lesion of dental disease by means of the germ, they have failed. Koch's postulates require this to be done in order to prove that a specific bacteria is the cause of a certain disease. Forsyth Dental Infirmary was opened in 1914, and shortly after that time, Dr. Howe was invited to continue his dental research work at the infirmary. At that time, he worked with Miller's chemicoparasitic theory and did considerable work with the different forms of aciduric bacteria. In no case was he able to produce anything resembling dental caries, by means of either injecting the bacteria into the experimental animals or applying them locally. It was only when he turned to the field of nutrition that he was able to produce caries and other dental troubles. He has produced caries in the teeth of experimental animals and can repeatedly do so by withholding certain vitamines and instituting irregularities in the mineral content of the diet. No claim has been made that nutrition is the only factor in dental decay, but it is known that diet plays an important part in the welfare of the dental structures. Too little is known about mineral metabolism, utilization of ingested materials, calcification, the endocrines and a number of other questions, and until more is known of these subjects, we will have to continue searching in the hope that some day we shall find the cause and cure of dental decay.

Dr. Bunting: The remarks of Dr. Eliot furnish an example of one type of false concept in regard to dental caries which was referred to in this paper. His statement that dental caries had never been produced by means of *B. acidophilus* disregards a large amount of experimental work in which actual carious lesions have been produced in the test tube and in the mouth and have been reported by various observers. Our own work, as reported in THE JOURNAL and elsewhere,[20] shows very definite carious lesions which were produced by the application of *B. acidophilus* to the surface of the teeth in the mouth by means of clasps. Therefore, the statement that Koch's postulates have not been fulfilled because dental caries has never been produced by means of this organism is erroneous. I agree with Dr. Eliot that we must know more about nutrition and metabolism in their relationship to dental caries, but I am also certain that we will never solve the problem of dental caries unless we give due consideration to the bacteria which are the active causative agents of the disease.

20. Bunting, R. W.: Oral Pathology, Philadelphia: Lea and Febiger, 1929, p. 187.

DENTAL CARIES*

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THE fact that the activity of dental caries varies greatly in different persons has long been observed clinically. It can now be reduced to exact figures by the use of the caries index.[1] As an instance, H. Holliday and D. E. Ziskin, of the Department of Oral Diagnosis of the Columbia University, School of Dental and Oral Surgery, have shown in a group of 406 students of an average age of 17-19, a minimal caries index of 0 and a maximum of 54.375 per cent. Such extreme figures, showing the great differences in the activity of dental caries, can be duplicated in almost any dental practice. The thinking members of our profession, as well as the more advanced investigators, realize that food retention is not the sole cause of dental caries and consequently that oral hygiene is not the only method of combating this disease; for it is of no avail in preventing the progressive destruction of the teeth. Other means are now being sought to improve the dental condition of present and future generations.

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*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

1. Bödecker, C. F., and Bödecker, H. W. C.: Practical Index of Varying Susceptibility to Dental Caries in Man, D. Cosmos, 73:707 (July) 1931. Bödecker, C. F.: Calcification of Modified Index of Dental Caries. D. Survey, 7:23 (Dec.) 1931.

The beneficial effect of a balanced diet can be regarded as definitely proved. But how can diet benefit fully formed teeth if these are considered as having no physiologic connection with the body? There is a large group of investigators who, even though they realize that the teeth are benefited by a well-balanced diet, do not admit a biologic connection with the body. They believe that the teeth are fully matured on eruption, and that nothing can affect them for good or ill from the interior. Their explanation of the mechanism of dental caries centers entirely in a change of oral conditions. Variations in the chemical constitution of the saliva through which a defective diet may harm the teeth, are therefore thought to be responsible. Here again, there is a divergence of opinion. One group believes that an improper diet develops an abnormality of the saliva; another group that the growth of *Bacillus acidophilus* is stimulated by this means. The latter theory makes bacteria responsible for the increased activity of dental caries. Still another group believes in a combination of these two factors. The majority of investigators, as well as most of the dental profession, believe a variation of one or all of these factors to be the cause of dental caries.

Let us now turn to the constitutional or internal factors. Broderick,[2] in his work "Dental Medicine," presents a great many arguments to the effect that

2. Broderick, F. W.: Dental Medicine, St. Louis: C. V. Mosby Company, 1928.

the presence of bacteria and food retention around the teeth cannot wholly explain the varying activity of dental caries. His statements on this subject are so clear and logical that they should convince the open minded. He believes that the cause of dental caries is to be found in constitutional disturbances, particularly acidosis, and that this condition causes an abnormality of the saliva. He does not entirely preclude the thesis of detrimental influences affecting the dental tissues from within. Only a few investigators consider this to be possible. The majority maintain that no metabolic processes take place in the enamel and that therefore systemic disturbances cannot harm the teeth by way of the pulp. They do not believe that a mechanism exists by which this could be effected. It is not yet generally admitted that a fluid can penetrate from the pulp into the enamel, although the existence and permeability of channels leading from the pulp through the dentin and the enamel has been shown by Beust,[3] Fish,[4] Klein and Amberson,[5] Applebaum,[6] by me[7] and by others. The reason for this is that members of the dental profession, as well as many investigators, are obsessed with the idea that erupted teeth need no supply of mineral salts and therefore receive none. Consequently, they cannot understand that general metabolic disturbances may result in a derangement of the secretion of the dental pulp and that thus the dental tissues may be harmed.

Systemic disturbances will probably be shown to harm the teeth by abnormal changes in the dental pulp and mineral salt metabolism. These factors have been discussed at length elsewhere.[8] It is only necessary to mention them here. Suggestions concerning a dental protective mechanism against decay likewise have been published.[9] A brief recapitulation of a certain phase is necessary, as a modification has been made since 1929. The hypothesis was then set up that the dental pulp in children and young adults secretes a lymph which permeates the dentin and the enamel. This fluid was supposed to contain mineral salts which effect the posteruptive calcification of the dentin and enamel and maintain the high buffer power or alkali reserve of these tissues. That these appear to have a high alkali reserve is indicated by the work of Karshan,[10] who showed a hydrogen-ion concentration of 7.8, 8.0 for the dentin and 7.3-7.6 for the enamel. (Blood has a p_H of 7.35-7.40.)

Originally,[11] it was thought that the dental lymph itself might neutralize oral acids and thus prevent the destruction of the enamel and dentin. Another more recently suggested possibility is that the

3. Beust, T. B.: Vascular System of Hard Substance of Teeth, D. Rec., 32:660, 1912.

4. Fish E. W.: Circulation of Lymph in Dentin and Enamel, J.A.D.A., 14:804 (May) 1927.

5. Klein, Henry, and Amberson, W. R.: Physico-Chemical Study of Structure of Dental Enamel, J. D. Res., 9:667 (Oct.) 1929.

6. Applebaum, Edmund: Lymph Channels in Dentin and Enamel Stained by Amalgam, J. D. Res., 9:487 (Aug.) 1929.

7. Bödecker, C. F.: Permeability of Enamel in Relation to Stains, J.A.D.A., 10:60 (Jan.) 1923.

8. Bödecker, C. F., and Applebaum, Edmund: Metabolism of Dentin; Its Relation to Dental Caries and to Treatment of Sensitive Teeth, D. Cosmos, 73:995 (Oct.) 1931.

9. Bödecker, C. F.: New Theory of Cause of Dental Caries, D. Cosmos, 71:586 (June) 1929; Lipin Content of Dental Tissues in Relation to Decay, J. D. Res., 11:277 (April) 1931.

10. Karshan, M.: Studies of Enamel and Dentin in Relation to Dental Caries, J. D. Res., 12:523 (June) 1932.

11. Footnote 9, first reference.

lymph maintains the high alkali reserve in the dentin and enamel through a constant supply of mineral salts (bicarbonates?). Thus, under normally healthy conditions, dental caries would be prevented in young persons. However this may be, the pulp and its secretion, the dental lymph, probably aided by a normal saliva (Eckermann,[12] Broderick[2]), appear to me to be the principal factors in maintaining the integrity of the teeth.

Lester R. Cahn[13] now goes even farther, believing that under pathologic conditions, the dental pulp can decalcify the dentin and enamel from the interior, caries resulting in the areas of food retention. This has been shown to be possible by Blackberg and Berke,[14] who observed in young rachitic pups areas of decalcification definable only by the roentgen rays, and extending from the pulp to the surface of the tooth. If these observations apply to human teeth, the cause of dental caries will be found to inhere in systemic rather than in environmental conditions. It appears that the activity of this disease is dependent on bodily conditions. This does not mean that oral hygiene is unnecessary; for if mouth acid (due to food fermentation) is the exciting cause of dental caries, the less food that is retained around the teeth (less acid), the less active need be the protective mechanism to combat oral acid and still maintain the teeth intact.

The close relation of the environmental causes of dental caries (food retention, the presence of bacteria and the condition of the saliva) to the protective mechanism situated in the dental tissues, primarily in the pulp, explains some puzzling clinical observations:

1. The increase of the susceptibility to dental caries in persons during pregnancy or systemic illness in spite of rigorous oral hygiene.

2. The fact that unclean teeth do not necessarily decay if the activity of the protective mechanism is normal.

3. Unilateral approximal decay. This condition, although rare, may be noted occasionally in dental roentgenograms. It is incomprehensible, if we regard dental caries as being due solely to food retention, the presence of bacteria or even to changes in the saliva, for all these conditions must affect both closely contacting approximal surfaces. If, on the other hand, we accept the thesis that the alkali reserve of the calcified dental tissues is maintained by the pulp, and further that a pathologic pulp may abstract mineral salts from the dentin and enamel, unilateral approximal decay is readily explained. In this case, systemic conditions are probably not far below normal. The pulp in the affected tooth is pathologic (owing possibly to some local irritation) and therefore is decalcifying the dentin and enamel, making this tooth more susceptible to attack from without.

The supposition that the teeth may be affected by some internal mechanism which is in close physiologic connection with the body is considered by some to be pure speculation. In answer to this, I shall briefly enumerate the data on which the existence of a protective mechanism is based:

1. The odontoblasts of the pulp send dentinal fibrils throughout the dentin which join with the organic structures of the enamel rod sheaths.[7]

2. The dentinal fibrils are tubular,

12. Eckermann, R.: Dental Caries and Osmosis, 1919.

13. Cahn, L. R.: Pulp and Its Influence on Dental Decay, D. Cosmos, to be published.

14. Blackberg, S. N., and Berke, J. D.: Posteruptive Changes in Teeth of Dogs on Rachitogenic Diets, J. D. Res., 12:695 (Oct.) 1932.

thus allowing a greater flow of lymph.[15]

3. An organic matrix is present in the enamel. It is composed of: (*a*) tufts, (*b*) enamel rod sheaths, (*c*) lamellae and (*d*) enamel cuticle.[16]

4. The dentinal fibrils are seen to pass into the enamel, if the angle of the section is correct.[17]

5. Dentinal fibrils connect with (*a*) tufts, (*b*) sheaths and, occasionally (*c*) lamellae and (*d*) enamel cuticle (histologic evidence).

6. This entire system of channels penetrating the dentin and enamel is permeable from within in newly erupted teeth (shown by animal and human experiments.)[18]

7. The dental lymph can be noted with a low-powered binocular microscope in newly exposed dentin of noncarious, young, vital teeth.

Excavated cavities in carious teeth show very little lymph, as the dentin has become irritated by the decay and its permeability has been greatly reduced.[19] The presence of a slight amount of lymph is shown by the following common clinical observation: when a completely excavated cavity in a vital tooth has been dried with alcohol and hot air, the dentin takes on a chalky white opacity and a minute or two after desiccation, the dentin turns a translucent yellow. It appears that only the slowly exuding lymph can be responsible for this change in color.

The secretion of dental lymph must be greatest during youth, because the odontoblasts are then largest and most active and the dental tissues most permeable. Youth is also the time when the posteruptive calcification of the tooth occurs. Further, it is the period at which caries is highly active. This may indicate that the function of the pulp and the permeability of the dental tissues bear some relation to the activity of the disease at this time.

Recent data are based on the fact that

1. The observations of Blackberg and Berke[14] indicate that the dentin and enamel in rachitic dogs may be decalcified from within by the presence of an abnormal pulp. Hence, it is possible that the activity of the dental pulp may be harmful under certain conditions.

2. It has been shown by the elaborate work of Karlström[20] that enamel varies in hardness. He observed that this tissue was less hard in the interior than on the surface. Further, he proved that the enamel of matured, erupted teeth was markedly harder than that of newly erupted teeth, particularly in the interior. He came to the conclusion that the mineral salts for the posteruptive calcification of the enamel originated in the interior and not on the exterior (salivary salts). He also found that the dental enamel of pregnant women was not so hard as that of the "normal," particularly if the condition were complicated by systemic illness or improper diet.

15. Hanazawa, Kanae: Study of Minute Structure of Dentin Especially of Relation Between Dentinal Tubules and Fibrils, D. Cosmos, 59:125 (Feb.) 1917. Bödecker, C.F.: Soft Fiber of Tomes a Tubular Structure, D. Cosmos, 56:1378 (Dec.) 1914; J.N.D.A., 9:281 (April) 1922.

16. Bödecker, C. F.: Enamel of Teeth Decalcified by Celloidin Decalcifying Method, and Examined with Ultra Violet Light, D. Rev., 20:317 (April) 1906.

17. Kato, Seiji: Histological Study of Human Enamel, D. Cosmos, 71:1139 (Dec.) 1929.

18. Fish, E. W.: Age Changes in Permeability of Dog's Enamel, J. Physiol., 72 321-326 (July) 1931.

19. Footnotes 2-8.

20. Karström, S.: Physiologic and Pathologic Studies of Dental Enamel with Special Reference to Question of Vitality, Svensk Tandlak.-Tidskr., 1931, Sup. 1.

On the foregoing data[21] is based the idea that the varying activity of dental caries observed in different individuals is dependent principally on a dysfunction of the pulp and its secretion, the dental lymph. (Secondarily, the chemical constitution of the saliva may affect the caries susceptibility of the teeth, and influence the direction of the flow of lymph.) An abnormal pulp probably secretes an abnormal dental lymph; and instead of effecting the posteruptive calcification of the young tooth, it may even cause a decalcification, thus aggravating or even initiating dental caries.

CONCLUSION

Whether we regard dental enamel as a vital or a dead tissue in its reaction to dental caries seems to be a matter of definition. It is perhaps a question of whether the term "vitality" should be applied to a noncellular tissue (enamel) in which apparently metabolic activity occurs through the cellular processes of an enclosed organ (pulp). To me, it seems that the enamel does possess a low degree of vitality. Do we not consider dentin as vital or not vital, this depending on the presence or absence of a live pulp? And yet dentin is an "acellular" tissue, as far as it contains no nucleated cells.

The entire question revolves around the following:

1. Are newly erupted teeth less highly calcified than mature ones?

2. Do the mineral salts which effect the posteruptive calcification of the teeth, originate from the blood in the dental pulp?

3. Can fully erupted teeth be harmed by systemic disturbances by way of the pulp? And can this explain the varying activity of dental caries in different individuals and at different ages?

If we answer these questions in the affirmative, and I think some of us can, we must regard the enamel as a tissue closely dependent for its welfare on its physiologic connection with the body, particularly during youth. Thus dental caries will finally prove to be caused mainly by systemic disturbances.

21. Footnotes 1-9.

630 West 168th Street.

THE SPRING LOCK DENTAL RESTORATION AND THE DISTAL EXTENSION BRIDGE DESIGNED UPON THIS PRINCIPLE*

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DURING its history, dentistry has demonstrated many methods of replacing missing teeth by bridgework. The best minds in the profession have devoted themselves assiduously to improve this most important dental service. It is because of the accomplishments of such men as Goslee, Peeso and Chayes, to mention only a few, that restorative dentistry has made such marked progress.

In determining which type is the most suitable for a given case, many things must be considered. Good judgment is of prime importance, but it is often extremely difficult to reach a decision, owing to the multiplicity of details, particularly in the more complicated cases. Here, sound fundamental principles based on experience must be depended on to guide the dentist.

Experience has convinced me that the ideal appliance must satisfy four requisites:

1. Comfort. 2. Tissue protection of *(a)* the remaining teeth and *(b)* the periodontal and soft and hard tissue of the mouth; allowing freedom of tooth movement in function with no wedging and therefore no forced movement. The general health is also thus protected. 3. Esthetics. 4. Economy: *(a)* tissue and *(b)* monetary.

The patient's demand for economy may outweigh all others; or it may be esthetics, or esthetics and economy, or comfort and esthetics, which he may consider of paramount importance. In such cases, we are compelled to comply with the patient's desire, making our appliances meet this demand to as great an extent as possible. In our zeal to give the patient what he wants, we must be careful not to disregard or consider too lightly the other requisites, or much trouble and an inefficient appliance will be the result.

I believe that I can best answer the question "Why the spring lock insertion bridge?" by calling attention to what the bridge offers in these fundamentals. I do not assert that the spring lock insertion bridge possesses all of these requisites to so great an extent as some other type may possess any one requisite, but I believe that it possesses a maximum combination of these requisites in one appliance.

COMFORT

Like the properly made semifixed type of appliance, the spring lock insertion bridge cannot become displaced during mastication. It possesses far greater flexibility in its application as it is a removable appliance and is therefore not confined

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to small spans, but may be used to supply one or most of the teeth in the arch. This, together with the sanitary feature of the removable bridge, gives it great latitude. At the same time, in all instances, there is perfect resistance to displacement during mastication, as it is held firmly in place by automatic locks. (Fig. 1, *C, K, D,*). This is one of the new and principal features of this bridge and one which is appreciated by the patient.

On removal, there is no binding, as it does not depend on friction of any kind to hold it in place, and therefore

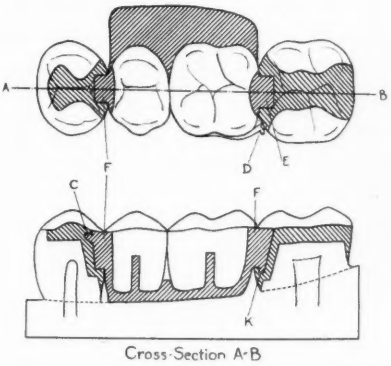

Fig. 1.—Top and cross-section of unilateral bridge; illustrating support and retention of spring lock insertion bridge. Here are shown anterior lock *C,* spring lock *D,* 30-degree floor on the anterior rest and retention *K* on the posterior.

no pulling or tugging is necessary. The slightest finger pressure releases the spring lock (Fig. 1, *D*), which causes it literally to fall out, and the faint click of this lock as it goes to place on insertion gives the patient that sense of security and comfort which he can enjoy only when he knows that his artificial teeth cannot possibly become displaced to annoy or embarrass him.

Another feature of this bridge is that all of the tissue-bearing parts are constructed as one entity and the tooth-bearing parts as another. This not only offers much by way of comfort to the patient, as it minimizes abnormal stress on the abutment teeth, but it also gives the dentist a vast amount of comfort when he finds, since none of the rests or locks need be disturbed, how easily these cases can be rebased; and, by no means least in importance, there are no broken attachments to be replaced.

TISSUE PROTECTION

If we can design an appliance that will be efficient and will not cause or

Fig. 2.—Tilting of actual case as it is being put in place; showing necessity for proper clearance.

encourage caries, trauma or pulp involvement, we have done much toward the protection of the remaining tissues. A spring lock insertion bridge never needs a devitalized tooth for its support. It permits exceedingly shallow inlay preparations (the rests occupy very little space), which, needless to say, adds appreciably to the protection of the dental pulp. The elimination of clasps helps greatly to prevent caries and trauma. The caries so often traced to this source, owing to wedging, is not understood and may need some slight elaboration. Probably the most frequent

cause of trauma from this source is the spring of a clasp appliance from masticatory pressure because of improper seating of the rests. This is often due to faulty construction, to be sure, but with this matter we are not concerned at the present moment.

I wish to draw attention particularly to the rest of an anterior or posterior abutment which, owing to the form or occlusion of the tooth, makes impossible the construction of a proper seat. Whenever the rest is placed on an inclined surface, trauma will ensue. In the case of a cuspid, for example, the sliding of the rest upon the inclined plane of the lingual surface, when pressure is brought to bear on it, forces that tooth buccally and places torsal trauma on the other abutments as the appliance is forced out of alinement. The buccal arm of the clasp restores them to position when pressure is released. Under such conditions, these tissues must deteriorate, and periodical disease ensue. Should the buccal arm of the clasp be removed for esthetic reasons, as is often done, the rest acts as an orthodontic appliance, moves the tooth buccally and defeats the purpose for which the rest is made.

Fig. 3.—Actual case in place; showing spring lock and position of ledge on molar inlay.

The periodontists claim that, from their point of view, it is often better to limit the amount of movements of a tooth, particularly when periodontal disease is present. The spring lock insertion bridge can be made to do this perfectly without interfering with any of its other qualities. When the sides of the rest fit snugly, they materially stabilize these abutment teeth. They are by no means a rigid splint, but they can be made in this way to limit materially the amount of movement. By loosening the rest, any degree of movement may be attained. Furthermore, by allowing a little clearance at the locks at *C* and *D*, provided the saddle has been snugly fitted, the resiliency of the gum will push the bridge occlusally when masticatory pressure is released and thus allow the rest period so necessary for the health of the tissues. At the same time, the circulatory stimulation, caused by the pressure and release of this saddle on the soft tissue during mastication, will minimize recession. When the attachments of the frictional types of restoration or clasps are loose enough to permit this movement, they are more often mixed up in the bolus of food then in place, while the perfect resistance to displacement of the spring lock insertion bridge during mastication is not affected by this play.

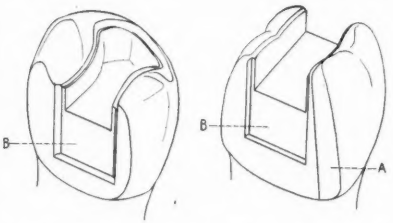

Fig. 4.—Slice preparations of abutment inlays; showing how shallow cuts *B* may be made and still give sufficient space to receive this type of attachment.

ESTHETICS

The esthetic features of the spring lock insertion bridge are about the same as those of the other better types of bridge. Any type of teeth and arrangement may be used. The fact that no clasps are employed, of course, offers an advantage, but it is one which the frictional and other types of attachments also possess.

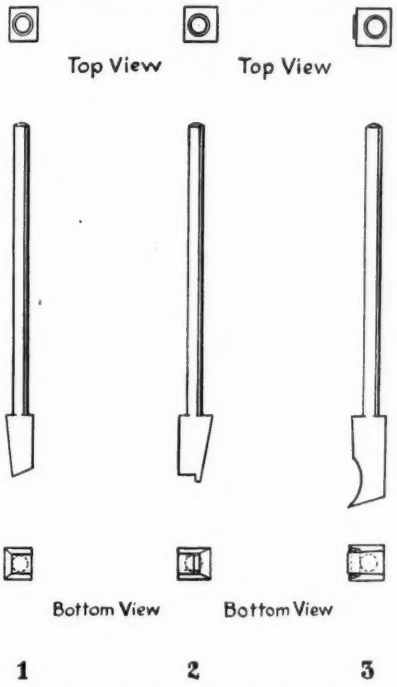

Fig. 5.—Enlarged view of mandrels used to cut rests in wax inlay pattern. Attention is drawn to the top, side and bottom views of each, illustrating the converging walls, which make absolute paralleling of these mandrels unnecessary, eye paralleling being all that is necessary.

ECONOMY

As stated previously, no extensive cutting of the teeth is necessary in the preparation of the abutment inlays. This assures tooth economy (more particularly as there are no clasps to injure the teeth) and a minimum of trauma, which makes for better health and for economy of all tissues.

From the viewpoint of monetary economy, suffice it to say that there are no attachments to buy, parallel or replace. It is true that this bridge cannot be compared in cost with the rubber partial plate, but then the latter, with respect to comfort, tissue protection and esthetic values, cannot be compared with the spring lock insertion bridge.

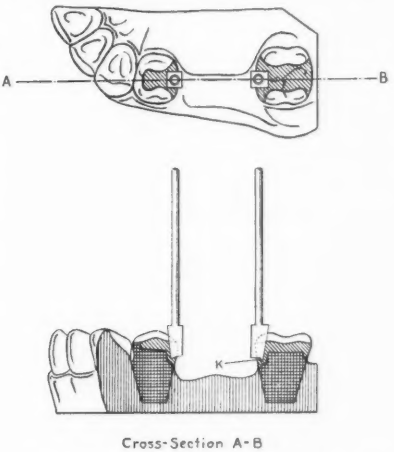

Fig. 6.—Amalgam models mounted with waxed inlays in place and eye parallelarity of mandrels after they have been used to pare away wax to form rests.

Since our presentation of the spring lock bridge to the New Jersey State Dental Society in May, 1930,[1] we have developed this appliance appreciably. During this time, we have gained considerably more experience with it and we have added several refinements and

1. Neurohr, F. G.: D. Cosmos, 72:1299 (Dec.) 1930.

simplified the procedure considerably, but its fundamental principles and the claims made for it remain much the same:

1. Elimination of clasps. 2. Maximum pulp protection (permits shallow preparation). 3. Elimination of the need of absolute paralleling. 4. Easy removal and insertion (no tugging or pulling necessary). 5. Complete resistance to displacement during the process of mastication. 6. Maximum periodontal protection: *(a)* less interference with the normal functional movements of the abutment teeth (promoting circulation and health) and *(b)* materially lessening of the forced movement of the abutment teeth by the appliance (including both wedging and overload, two of the primary causes of periodontal disintegration). 7. Inclusion of any one, two or all three fundamental objectives of saddles in the same appliance at the same time, tooth-bearing, tooth-and-tissue-bearing or practically all tissue-bearing. 8. Facilitation of rebasing of tissue-bearing parts of the appliance (whether entirely or in part). In addition, there are no attachments, and therefore none to replace.

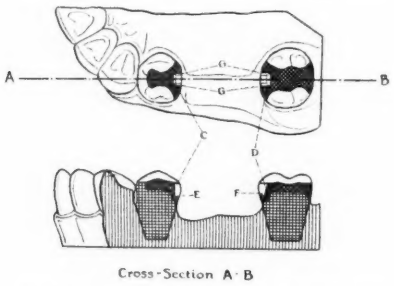

Fig. 7.—Mandrel impressions in wax patterns after former have been removed. These patterns are ready to be invested and cast in abutment gold.

Figure 1 shows a simple spring lock insertion bridge supplying the second bicuspid and the first molar, the construction of which will be taken up in some detail. The view above shows two inlays, two pontics, and two rests. The line A-B, passing through the occlusal surfaces of these teeth, demonstrates the supposed cutting of this model, the cross-section of which appears below it.

Attention is drawn, in the cross-section, to the inlays, rests and pontics. The rests, of course, take the burden of mastication. The insertion pin *C* prevents the anterior end of the bridge from coming out of place, while the spring wire *D* (above), which catches under the ledge in the inlay, prevents the posterior end from being displaced. The lock *K* (cross-section) keeps the molar from being moved distally by the spring lock, while the 30-degree angle of the floor, in conjunction with the insertion pin, retains the first bicuspid in position.

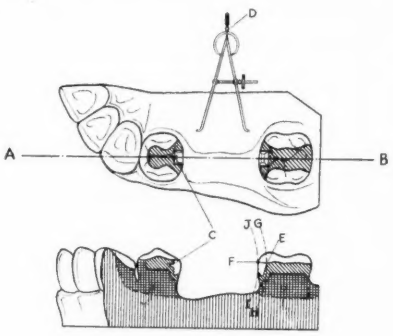

Fig. 8.—Metal seats with finished inlays in place (result of final impression); illustrating means of predetermining amount of clearance necessary for both saddle and posterior rest. The bridge is constructed and finished on this model.

In order to insert this bridge, it is

necessary to put the insertion lock in place first (Fig. 2), when the spring lock will follow.

Figure 3 shows the case in place with the spring lock wire caught under the ledge.

CONSTRUCTION

The teeth which are to act as abutments are prepared in the usual manner. If they are to receive inlays, the slice method (Fig. 4) may be the more desirable, but is by no means the essential one. The added slice extension (Fig. 4, *A)* is used on the posterior abutment to facilitate the placing of

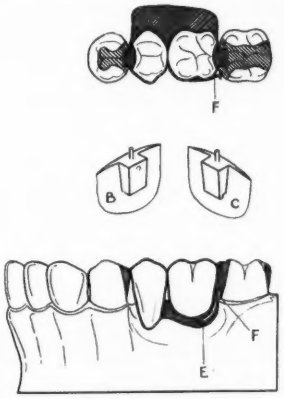

Fig. 9.—*B,* anterior and *C,* posterior, lock rest; showing apron cast with rests in order to facilitate soldering of them to struts of bridge. *E* and *F,* placement of spring lock wire and ledge on posterior inlay with spring lock caught under it.

the spring lock. The interproximal boxes (Fig. 4, *B)* need be only the depth of a small fissure bur (No. 557), thus keeping the cavity preparation well away from the pulp. This insures maximum pulp protection. Tube impressions and bite are now taken, the amalgam models made and mounted in the bite, which is poured, and the inlays waxed up, all in the usual manner.

The next step is to cut the lock rests into the waxed patterns. This is accomplished by means of mandrels (Fig. 5). No. 1 is for the insertion lock or the ordinary rest, while No. 2 is for the spring lock. No. 3 is for another type of insertion lock, but, as this type is seldom used, it will not be discussed here. Please note that the pulpal, lingual and facial sides of these mandrels are not parallel. (Fig. 5, below). This eliminates the need of absolute paralleling. Eye paralleling is all that is necessary. The value of this, I am sure, needs no comment. Attention is drawn also to the bases of these mandrels, the 30-degree angle of No. 1 and the retention base of No. 2. It has been found unnecessary to use these mandrels in a variety of sizes. Experience has demonstrated that one size only is needed for the spring lock, but that it is often advantageous to have a smaller size for the insertion rest. Particularly is this true when an anterior tooth is used. For this reason, the two sizes are available.

These mandrels, slightly warmed, are now used like chisels to pare away the wax until their positions are similar to that shown in Figure 6. Again, eye paralleling is all that is necessary.

When the mandrels are taken away (Fig. 7), the rests should automatically embody the following features: 1. They should be as deep as the preparations will allow when the pulp is well protected (definite floor). 2. The floors at E and F should be retentive. Thus, any inclination to displace the abutment teeth, as well as any wedging, is eliminated when masticating force is applied to the finished bridge. 3. The pulpal walls, very slightly at *C* and considerably more at *D,* must diverge gingivo-occlusally. (The necessity for this will be explained later). 4. The facial and lingual walls *G* converge toward the

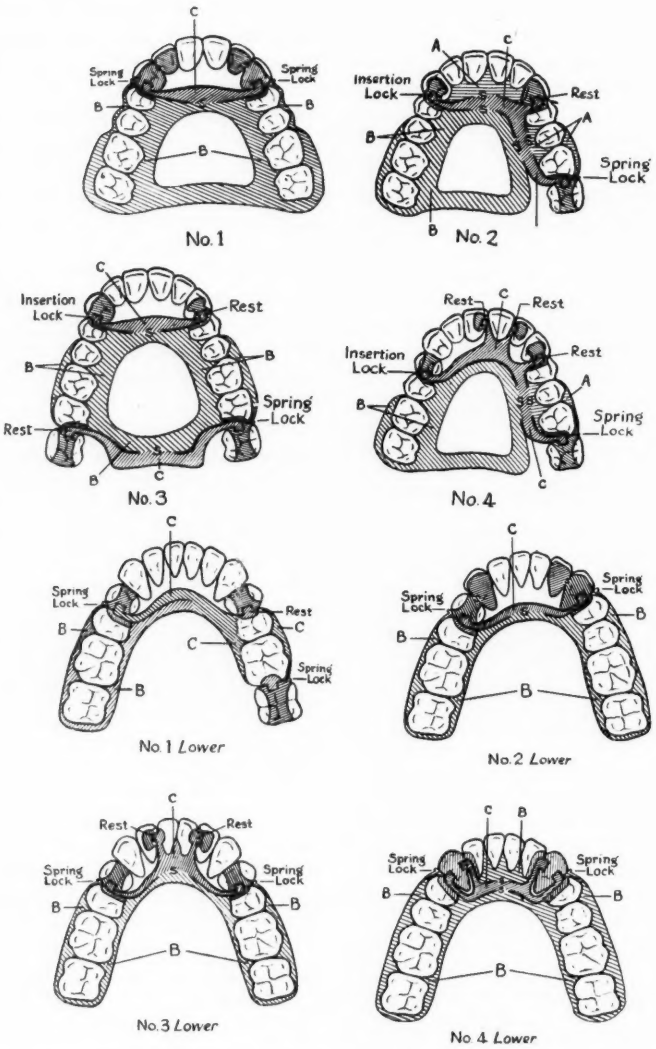

Fig. 10.—New principle of saddle design; showing tooth-bearing parts (*C*), including rests and attachments as one entity, tissue-bearing parts as another (*B*) and the manner in which these entities are joined by small amount of solder. At *S*, the remoteness of this joint governing the tissue-bearing properties these saddles possess, also the facility of rebasing as explained under saddle design, are indicated.

base of the rest, thus eliminating the need of absolute paralleling of rests. 5. The rests should be clean cut; that is to say, they should have flat sides and sharp line angles.

The matrices are now invested and cast in hard gold, by accepted method. After they have been trimmed and finished, they are tried in the mouth and checked for fit and occlusion. A plaster impression of the case with the inlays in position and a bite are now taken. The inlays are then placed in the impression, metal seats made and the models poured and articulated in the usual manner.

The anterior inlay is now removed from the model and, by means of a fissure bur, the depression *C* (Fig. 8) is cut into the occlusal gold, from 0.5 to 1 mm. deep and approximately parallel to the base of the rest. The end of a piece of 19-gage round clasp wire about one-half inch long is now fitted loosely in this depression and put aside.

By means of a pair of calipers, the ends of which have been turned (Fig. 8), measurements are now taken in order to determine the amount of clearance necessary for the distal end of the saddle and for the posterior lock rest when the finished bridge is swung into position. These measurements are extremely important. A slip here will mean much future trouble; hence, the utmost care and precision must be observed.

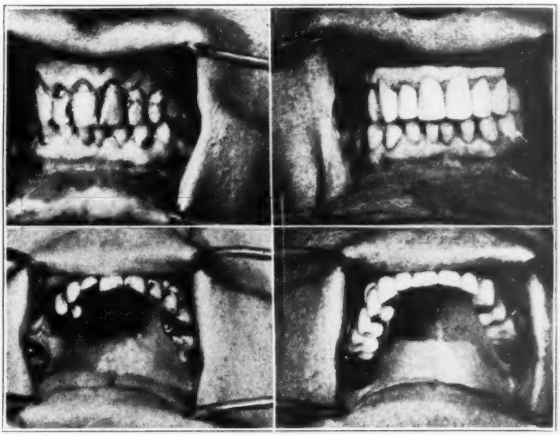

Fig. 11.—Two views of practical case, before and after restoration. The upper left first and second bicuspids were extracted. All other pulps were and still are vital. On the two central and two lateral incisors and the right cuspid, there are jacket crowns. On the right first bicuspid and left cuspid are thimble jacket crowns. (Neurohr, F. G.: Adaptation of Jacket Crown to Bridge Abutment, D. Items Int., 53:435 [June] 1931.) The two second molars were restored by gold castings. The second bicuspid and first molar, on both sides, have been restored by unilateral spring lock insertion bridges.

With the center in the depression at *C* (Fig. 8), and a radius *C-E*, the point of the calipers is now allowed to drop to the base of the lock rest. If it binds against the pulpal wall of the rest on the way down, it is proof that it is within the arc *G-H* and we can be sure that sufficient clearance has been allowed. In other words, the distance from *C* to

the top of the lock rest *E* must be greater than from *C* to the pulpal base of the rest. On the other hand, should it not bind against this wall, the latter must be given more slant, and thus the radius *C-E* of the arc be increased until the desired result is accomplished.

Again with the center *C* and a radius *C-F* (Fig. 8), a mark is now made at *I*, indicating the posterior extremity of the saddle. That is to say, the distance from *C* to the highest point of convexity *F* must be greater than from *C* to the posterior extremity of the saddle *I*.

The rests are now oiled and filled with inlay wax, the wax being allowed to come over the interproximal surface of the inlays to form an apron. This facilitates the soldering of these rests to the bridge later. The occlusal surfaces of these rests are trimmed flush with the inlays. The piece of clasp wire which had been fitted previously into the insertion rest of the anterior abutment is now heated, pressed through the wax, and held against the occlusal aspect of that depression until the wax congeals. Sprue wires are then inserted in the occlusal portions of these rests, when they are invested and cast in one of the hard saddle golds.

With the rests in their seats, the porcelain teeth are ground in, in the usual manner. If the aprons interfere with the contact points, they are taken down. The mesial surface of the bicuspid and the distal of the molar are ground to facilitate the strut. The saddle is then waxed up, care being observed to provide a sufficient amount of gold saddle around the buccal side of the molar to facilitate the spring lock *E* (Fig. 9).

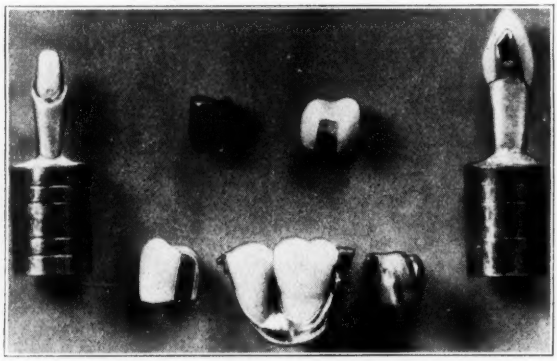

Fig. 12.—Upper right spring lock insertion bridge complete with abutments used in restoration of case shown in Figure 11. Upper row, left to right: thimble jacket crown, amalgam model, thimble with strut, porcelain jacket and assembled thimble jacket crown. Lower row, left to right: thimble as anterior abutment with insertion lock rest in strut, spring lock bridge showing anterior rest and lock pin, also spring lock and posterior rest, and inlay with posterior rest and spring lock ledge.

By shaping a piece of 18-gage soft copper wire, which is easily manipulated, in the approximate form that the spring lock is to take and then, by warming it slightly, a groove is cut in this wax. This groove not only makes a nicer finish (since it depresses the spring wire so that it is flush with the surface of the saddle), but it also acts as an important check, of which I shall speak

later. The wax saddle is now invested and cast in the usual manner in a hard saddle gold.

After the saddle has been trimmed and polished and the teeth fitted, it is replaced on the model, and the anterior rest fastened to it with sticky wax, invested and soldered. This operation is repeated with the posterior rest. The case is now finished with the exception of the spring lock wire.

THE SPRING LOCK[1]

The spring lock must embody certain requisites: 1. It must have sufficient length. 2. It is desirable but not necessary to get torsional as well as flexional give. (When properly made, the demand for spring is little more than the diameter of the wire itself). 3. It must be depressed as much as possible in the interproximal abrasure. 4. The porcelain pontic must act as a stop so that the wire may not be subjected to overflexion. 5. The groove in the saddle must act as a check to prevent an undesirable amount of play and at the same time to enhance stability.

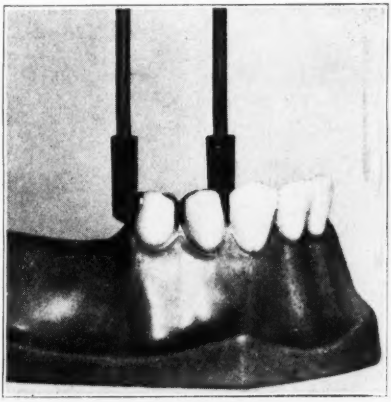

Fig. 13.—Two bicuspid inlays waxed up with No. 1 mandrels in position.

If these requisites have been built into the spring lock, it will have been correctly made and the operator will be spared any demands on the part of the patient for adjustment. An accident only can disturb it.

While the bridge is assembled on the model, the point for the ledge is marked on the inlay. This point must be just at the high point of contact and depressed into the embrasure as much as possible. The spring lock inlay is now removed and, by means of a fissure bur, this ledge is cut into the inlay, the end of the bur defining the ledge, which should be about parallel to the line of occlusion. The case is now reassembled,

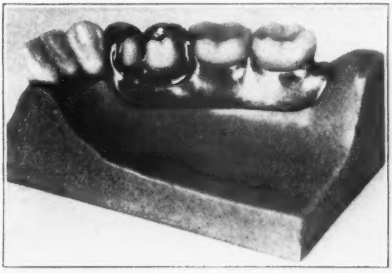

Fig. 14.—Lingual view of distal extension spring lock stretch; showing manner in which two rests are connected with bar and made one entity, and two molars with saddle another. The position of the saddle joint which joins these two entities is to be noted.

but the porcelain molar is removed. As the strut and rest are narrower than the frictional attachments, owing to their construction, free access can be attained to the ledge. With the technic employed to conform a wrought wire clasp, a 19-gage round clasp wire is now bent into position. The ledge is used as the starting point and the conformation of the wire is continued with pliers until it enters and follows the saddle groove. At the point just under the ledge, a scratch

is made on the wire to mark the position of the handle. A small piece of the same kind of wire is now soldered to it at this point, being locked in place with a pair of lock tweezers and soldered in the open flame. The spring wire is then placed in position on the model antifluxed to within 1 mm. of its end, fastened with sticky wax, invested and soldered to the bridge. Great care should be observed to use a minimum amount of solder and that only the very end (Fig. 9, *E)* is fastened or the spring of the wire will be interfered with if not destroyed entirely.

After the bridge has received its final polish and is placed back on the model, we sometimes find that the molar porcelain interferes with the action of the spring lock. By gradually stoning a groove in the distal surface of this porcelain opposite the spring lock, we effect sufficient clearance. Care should be observed not to take away too much porcelain as it acts to prevent the overflexion or buccal distortion of the wire. This is of the utmost importance. The amount of necessary movement of this wire is little more than its own diameter, for the depth of the ledge from which it must be disengaged on removal is only one-half the diameter of the wire. This shallow but sharp-angled ledge is ample to hold perfectly and allows the spring wire to go all the way back, which not only makes the bridge tighter, but, as the bridge goes into place, causes that reassuring click.

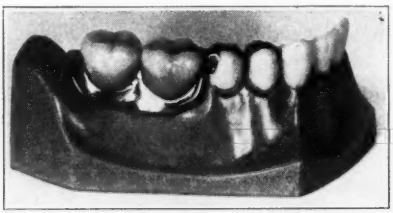

Fig. 15.—Facial view of distal extension spring lock bridge. The position of the spring lock is to be noted.

BILATERAL BRIDGE

Just a few words at this point on the bilateral application of this type of appliance. It is emerging from its developmental stage. We have found, beyond doubt, that the fundamental principles of this type are applicable at this stage. Moreover, the well-known principles of bisection, or of triangular retention in the selection of the abutment for the locks, have proved most acceptable (Fig. 10). We have found also that it is rarely necessary to use more than two locks. These may consist of two spring locks such as would be used in the case of the lower lingual bar where all of the molars are missing, or of one insertion and one spring lock as shown in Figure 10, above. It is often essential to supplement them with one or several rests. A definitely seated rest is always the most desirable

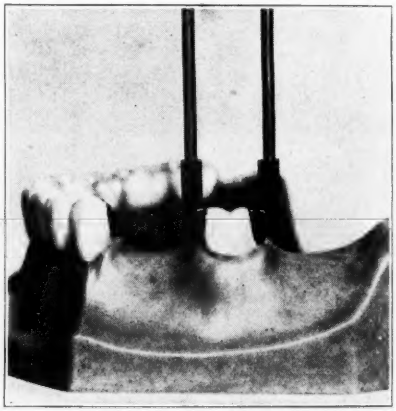

Fig. 16.—Manner in which molar inlay is waxed up with two No. 1 mandrels in position.

type. The No. 1 mandrel may be used for the same purpose with excellent results as it automatically gives sharp angles and flat nonparallel walls and a 30-degree slope to the floor. It is now an established fact that trauma will ensue unless all rests are definite. By definite, we mean an inlay within an inlay; the seat in the female inlay offers an angle slightly acute to the line of force, and the sides of the female portion are flat and nearly parallel. This provides accurate placement and, at the same time, prevents wedging, both of which features are extremely important.

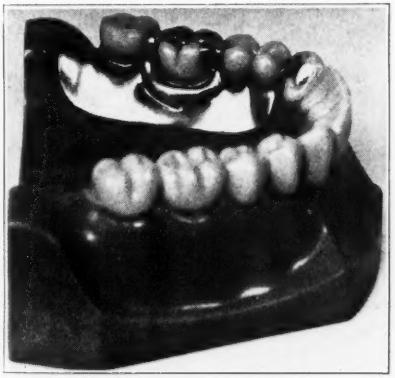

Fig. 17.—Lingual view of one tooth distal extension spring lock bridge; showing bar joining two molar rests and saddle supporting porcelain teeth, and manner in which they are joined together.

The exact predetermining of clearance has been well worked out. Clinical data are also sufficient to afford a well-established procedure. We are confident that the mechanical and biologic requisites are greatly improved by this type of appliance.

SADDLES

The same thing is true of the saddles and stressbreakers (Fig. 10). Many of the details of this procedure likewise have become firmly fixed. The principle is positively established that all of the entirely tooth-bearing parts of the appliance, including the rest, should be one entity and the tissue-bearing parts another. It is desirable to have these entities in as few parts as possible. This I believe to be another step forward in removable bridge design, a principle which will become fundamental in correct bridge design.

The manner in which the entirely tooth-bearing parts are joined to each other, that is, by means of small spans, rests and attachments, can be seen by

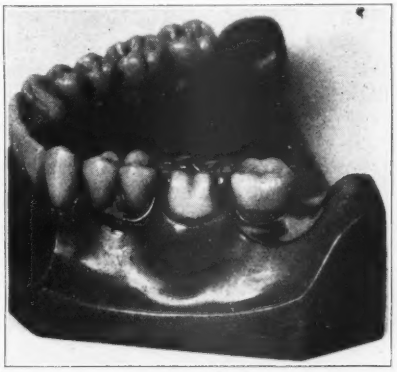

Fig. 18.—Manner in which spring lock wire is joined to appliance.

studying the designs in Figure 10. The principle involved will be appreciated when it is noticed how these parts are joined to the tissue-bearing parts which have been treated in like manner, that is, assembled by the soldered joints *S*, the remoteness of these joints deciding the tissue-bearing properties the respective parts are to possess. Thus, we see that the *B's* possess the maximum and the *A's* just enough to yield the slightest bit and so cushion the impact. The *C's*, which include the rests, are entirely tooth-bearing as they should be.

Not the least advantage of this arrangement is the simplicity with which the tissue-bearing parts can be rebased. The soldered joints *S* are simply opened, the parts reassembled in the mouth, plaster indexes taken of their relation to the joints, the latter resoldered, and the teeth brought back to occlusion by means of shims or by the addition of porcelain of medium fusibility.

Attention is drawn also to the anterior and posterior bars (Fig. 10). The double bar design is used almost without exception in our office on bilateral upper appliances, because far greater rigidity is obtainable with less bulk since these bars are in different planes. This increased strength is assured by the characteristic of this design to present the width and not the thickness of these bars to flexional force.

THE DISTAL EXTENSION SPRING LOCK BRIDGE

The replacement of missing molars and bicuspids when only the incisors remain has always been a serious problem. It becomes considerably more acute when the molars are missing on one side only and all of the teeth on the other side are in place, in good health and good repair. It is this unilateral bridge which we wish to take up at this time.

Dr. Peeso designed an appliance for this purpose which he called the distal extension bridge. This appliance marked a progressive step in the attempt to solve this problem. Dr. Chayes drew the attention of the profession to the detrimental effects of a distally extended saddle on the abutments. He asserted that the loosening of these abutment teeth was due to the rigid attachment of the saddle to these abutments. To overcome this objection, he designed what he called the cantilever bridge, which, by means of an ingenious stress-breaker, modified to a considerable extent the stress on the anchors. Both of these appliances necessitated the devitalization of one or both teeth. In an attempt to facilitate further the restoration of these cases, with tooth and tissue conservation, we have designed the distal extension spring lock bridge. Again, the spring lock principles of restoration have been employed. The tooth-bearing parts of the appliance have been joined into one entity and the tissue-bearing parts into another. Later, these are soldered together, the remoteness of the soldered joint controlling the tissue-bearing properties which these saddles will aggregate.

The two lower bicuspids are as a rule not very strong teeth, and although it is against our convictions to splint teeth together, we feel that, where these teeth possess the same degree of tightness, it is the lesser of the two evils to solder the two abutment inlays together, particularly where these teeth possess approximately the same functional movement. The joining of these teeth increases their ability to resist torsional stress. This is a simple rule of mechanics. Any torsional pressure on these teeth under these conditions is taken up by the entire length of the root instead of the gingival crest as would be the case if the teeth were allowed to remain as separate entities. Where these teeth are not of the same degree of firmness or we feel that fixation is detrimental, a stapilator is resorted to. This is accomplished by cutting a rest either in the distal portion of the first bicuspid or in the mesial of the second and by allowing the wax pattern of the other inlay to extend into it.

The inlays are prepared with as nearly parallel slices as possible. These slices are extended to the maximum

length. Particular attention is drawn to these two requisites of the preparations as they materially add to the retention of these anchors. Maximum anchorage of these inlays is of extreme importance. Whenever teeth are splinted together, displacement stress is appreciably increased. This stress must be provided for by increasing proportionally the retentive form of each anchor, thus offsetting the markedly increasing tendency to dislodge the castings whenever two or more teeth are splinted together, and insuring the serviceability of the appliance. Where the teeth are short, three-quarter crowns are resorted to in order to procure this maximum retention, the importance of which can be easily understood when we realize that the loosening of one of these abutments will throw the entire appliance out of line.

CONSTRUCTION

The indirect method of waxing up these inlays is employed. The No. 1 mandrel is used to provide the two female rests on the mesial surface of the first bicuspid and on the distal surface of the second bicuspid (Fig. 13). This is accomplished in the manner previously explained. The inlays are then cast in a hard gold and checked in the mouth for fit and occlusion, and a plaster impression is taken with these two abutments in place. Metal seats are now made for the castings which have been replaced in the impression and the model is poured in one of the hard plasters and articulated. The two inlays are then waxed together with sticky wax and fastened together by means of a small amount of solder.

Should there be any doubt that all undercuts have been removed between these slices and the walls of the preparation, it is better to try the inlays in the mouth just after the soldering operation to make sure that they will go to place. When we are certain that they slip easily into the prepared teeth, they are placed on the model and we are ready to construct the remainder of the restoration.

By relieving the mesial-lingual aspect of the first bicuspid only (Fig. 14), we facilitate the waxing up of the rests and provide sufficient space for the bar which connects them. The rests are now waxed up by the method already described, except that they are joined by the bar illustrated (Fig. 14). This bar should be kept below the gingival tissues and made thicker than we wish the finished bar to be. This procedure makes it possible to relieve with a carborundum stone the surface which comes in contact with the tissues when the bridge is finished and so avoid any possibility of soft tissue irritation from this source.

A sprue wire is now inserted and the wax bar invested and cast in clasp gold. It is then finished and placed on the model. The molar teeth are now ground in place and waxed up in the usual manner, except that the lingual flange of the saddle is extended along the margin of the bar to the anterior rest (Fig. 14). Provision also is made at this time for the spring lock on the buccal flange of this saddle (Fig. 15). This procedure does not vary from that already explained. The saddle is then cast in a hard gold and, after it has been entirely finished, it is placed back on the model.

Attention is now drawn to the fact that we have constructed the tooth-bearing and the tissue-bearing parts of this appliance as separate entities. The amount of movement or, shall I say, of tissue-bearing properties which this saddle will possess depends on the remoteness of the soldered joint which fastens these two entities together. It must be

left for the operator to decide what amount of movement is most suitable for a particular case. In making this decision, the operator must take into consideration the condition of the ridge and the bite. We have found that there is generally a tendency to give the saddle too much movement rather than not enough.

After the extent and placement of the soldered joint have been decided on, sticky wax is placed at this point, fastening the saddle and the bar together. When a suitable antiflux is inserted in that part of the joint which is to be left open, the appliance is removed from the model, invested in the usual manner and soldered. When we are satisfied that the appliance is again seated properly on the model, a spring lock wire (Fig. 15) is constructed in the usual manner.

By this procedure, absorption of these tissues has been minimized. Because of the stimulating effect of pressure and release which this design of saddle places on the soft tissues, and the fact that these tissues receive no pressure during the rest periods, any tendency to absorption of this ridge has been minimized. In the event absorption does take place, it is a simple matter to open the soldered joint, register a new relation in the mouth between the tissue-bearing and the tooth-bearing entities of this appliance by means of a plaster index, pour a new model, resolder the joint and shim the teeth with cement or add the necessary amount of porcelain of medium fusibility to their occlusal surfaces to bring them into occlusion.

Figure 16 shows a case the principle of construction of which is similar but which varies in some of the details. As the two-tooth span is too small to be entirely tissue-bearing, it must depend on the cuspid and the molar tooth to take up some of the stress of mastication. The molar pontic, on the other hand, must be almost entirely tissue-bearing as there is no posterior here. Therefore, by connecting the mesial and the distal rest with a bar in the same manner as in the preceding case, and by constructing an inlay rest in the cuspid, it becomes possible to grind in the teeth and to wax them up as one entity. The cuspid rest is soldered to the strut while the bar connecting the other two rests is soldered as shown in Figure 17. Note that this soldered joint has been placed toward the mesial aspect of this bar. This has been done purposely, as by this means we are able to allow the maximum tissue-bearing properties in the second molar region with slight tissue-bearing properties in the second bicuspid and practically none in the first bicuspid.

The spring lock wire is constructed in the usual manner (Fig. 18). Only one is required as the rest in the distal surface of the molar and the rest in the distal surface of the cuspid, in conjunction with this spring lock wire, will retain the case firmly in position. This principle of joining the tooth-bearing parts into one entity and the tissue-bearing parts into another allows great versatility and enables the operator to embody any one, two or three of the fundamental objectives of saddles in the same appliance and at the same time if so desired. Even in such a small appliance, we have almost entirely tissue-bearing properties in the second molar and slight tissue-bearing properties in the bicuspids, while the remainder are entirely tooth-bearing.

DISCUSSION

Carl W. Hoffer, Nashville, Tenn.: The spring lock with the attachments so designed adds another step to the advancement of dentistry. Some clasp cases are too tight today, too loose tomorrow; and every time we tighten a clasp, we shift practically every tooth to a new position. After a

short time, tooth wear takes place followed by discomfort from sensitiveness, often accompanied with decay. Next, the wearing or breaking of the so-called rests follows, with impingement of the soft tissues and loss of occlusal function, and the thought always before us that it may dislodge at the wrong time. Dr. Neurohr has had very pleasing results with the use of the spring lock. In regard to the stress-breaking qualities of fixed removable cases, we have two entirely different foundations upon which we are constructing our cases; and if this fact is not considered, we are running a great risk of failure in the end. Therefore, on the semisolid or tissue-bearing surfaces, we must have a self-adjusting force equalizer in order that we may take care of the differences in foundation, or tissue-bearing plus tooth-bearing. By this means, Dr. Neurohr has been able to equalize the pressure by his stressbreaking construction, lightening the great amount of stress that would otherwise be thrown on the abutment teeth, and absorption is overcome in the soft tissues by intermittent pressure acting as a stimulator, which suggests a possible source of nutrition for these soft tissues. If we have failed to diagnose the case correctly in the beginning, and have failed to establish individual occlusal function, any type of bridge that we may insert will be a failure. On the other hand, if we are careful in making the diagnosis, study the soft tissues and the bony support of the remaining teeth, distribute the stress equally over the remaining ones, and replace the lost ones without occlusal interference, we can look forward to a happy outcome of the case for our patients and for ourselves.

TREATMENT OF MALOCCLUSION AND LOSS OF RETENTION IN FULL DENTURE PROSTHESIS*

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THE very generous contributions of recent years to the literature of denture prosthesis have afforded us many opportunities to become familiar with the fundamentals of design and construction of artificial dentures, and in a degree, we have succeeded in learning the technic of diagnosis, impression taking, and articulation of teeth, etc.; and, with or without the aid of technicians, we have been able to build dentures in compliance with the esthetic and functional requirements of our patients. While thus engaged, we have come to realize that, though our problems are largely of mechanics, we have to deal with specific biologic conditions as well, since the residual structures within the oral cavity, in particular of the edentulous patient and the rest of his body in general, are parts of a living organism.[1] Artificial dentures, be they ever so correctly fitted and occluded, cannot be expected to remain in proper adjustment for any definite or specific length of time.[2] It is with the study of the resultant disturbances and with methods of correction and alleviation that this paper has to deal. In the main, success in full denture construction is dependent on two

*Read before the Section on Full Denture Prosthesis at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

1. Wright, W. H.: Tissue Changes Under Artificial Dentures, J.A.D.A., 16:1027 (June) 1929.

2. Hanau, R. H.: Occlusal Changes In Centric Relation, J.A.D.A., 16:1903 (Oct.) 1929.

principles: the establishment and maintenance of retention and balanced occlusion. Every painstaking operator endeavors to meet these essentials to the best of his ability. This does not preclude the possibility of error on occasion, and, as a result, we find need at times for correcting the form of the denture bases as well as the occlusion before dentures can be delivered to the patient. It will be but logical, therefore, to include in this discussion the treatment of retention and occlusion of new as well as of previously worn dentures.

The earliest article which I found bearing on the subject was published in 1861, by J. Richardson.[3] He described two methods for refitting temporary dentures, the second being quite like the plaster wash method employed by certain operators of the present day. It consisted of perforating the dentures, applying a coating of soft plaster to the inner or tissue side and inserting and positioning them in the mouth; then asking the patient to bring the teeth into occlusion and waiting for the plaster to harden. After the dentures were carefully removed and the excess material trimmed off, the plaster was coated with a separating medium and the dentures were flasked and vulcanized, much as is done today. The correction of errors in the occlusion were not alluded to. We may assume that any attention given was as skilful as the technic of that day allowed, consisting primarily in a study of the errors present with the dentures *in situ,* and eliminating them by grinding the teeth till interference was overcome. This is but another evidence that much which we of today consider as original in technic has been practiced prior to our day and generation.

3. Richardson, J.: Refitting Temporary Plates, New York D. J. p. 110, 4:110, 1861.

Proceeding with our review, we find many references to similar articles, but it is not my intention to make this an historical treatise in particular. I do, nevertheless, deem it proper that we familiarize ourselves with what the past has to offer, considering also some of the contemporary articles reviewed in preparation of this paper. Among those deserving special emphasis are articles by M. M. House,[4] F. W. Frahm[5] and R. W. Tench[6] in regard to malocclusion in artificial dentures and rebasing of vulcanite dentures.

The treatment accorded new or previously worn dentures being in a large measure analogous, I shall first consider the care of dentures which have been worn for a time and in which deficiencies exist that may be due primarily to the biologic changes to which the oral tissues and related structures are subject. In all instances, it is advisable that a case history be obtained and recorded. The purpose of this and of the diagnosis which should follow is to furnish the operator with all available information. He may then make an intelligent prognosis. To begin with, it is necessary to determine the salvage value of the dentures in comparison with the advisability of constructing new dentures. In this connection, one must be careful to make a just appraisal of the dentures being worn, not necessarily of the intrinsic value of the teeth and the base materials, but of their value when employed for the purposes of taking new impressions and for new registration of positional

4. House, M. M.: Correction of Malocclusion in Artificial Dentures, J.N.D.A., 8:339 (April) 1920.

5. Frahm, F. W.: Malocclusion of Artificial Teeth, 38:641 (Sept.) 1916.

6. Tench, R. W.: Method of Accurately Remounting Vulcanized Dentures for Regrinding, 26:286 (May) 1920.

relations of the jaws and for condyle guide indications. We often find that, in spite of considerable change in the occlusal relation of the teeth, the bases, when checked individually for stability and retention, exhibit markedly good conditions, yet owing to the magnitude of the change in the positional relation of the bases, the teeth are so badly out of balance that only resetting will enable the operator to effect a proper correction. In other cases, the tooth arrangement is so fully in compliance with esthetic and functional requirements as to need little or no correction, yet owing to extensive resorption, the loss of adaptation, with consequent loss of retention, is so great that relining of the bases is the only remedy.

This recalls a point about which there has been more or less contention in the not too distant past; namely, the relative merit of good impressions and good occlusion. While some contended that perfect impressions were of prime importance, others were equally convinced that a perfectly balanced occlusion was of greater value. We all agree today that we need to strive for as much perfection in both as possible, and that, besides, we must give equal care and consideration to the registration of jaw relations. It is quite generally admitted that perfect impressions associated with improper occlusion will not enhance the stability of dentures, while perfect occlusion will contribute materially to the stability of dentures and consequently improve their retention or resistance to forces that would tend to displace them. Irrespective of how well we may succeed in balancing the occlusion and improve the retention, whenever correction is undertaken, a particular check-up should be made to see that the requirements of esthetics and phonetics are also complied with as fully as possible.

Thus far, we have implied more or less indirectly what probable deficiencies might be encountered in a survey of cases requiring correction. These I have classified as follows, according to the extent and type of the defects shown.

1. (*a*) Simple peripheral defects of the base.
   (1) Overextension.
   (2) Lack of adaptation.
   (3) Underextension.
   (*b*) Slight (lack of occlusal balance or cusp interference).
2. Some combinations of (*a*) (*b*) above.
3. Cases with good bases showing a bilateral occlusal change in centric relation up to 3 mm. retrusion.
4. Good denture bases showing a unilateral occlusal change of from 2 to 4 mm.
5. Cases with occlusal changes beyond correction limits by the regrinding method.
6. Good bases showing protrusive occlusion in centric relation (usually mandibular prognathous).
7. Cases showing marked loss of retention of one or both bases caused by too great an incisal overbite and corresponding loss of tooth contact in molar region.
8. Cases of temporary dentures showing loss of retention due to resorption and other conditions.
9. Cases in which teeth comply with requirements of esthetics and occlusion, but exhibit severe underextension, instability and lack of retention.
10. Cases with good bases in which the teeth are not in harmony with the patient's features, nor set in compliance with requirements of correct phonation.

This list is rather comprehensive, yet to it might be added other types, such as cases showing improper arch forms and tooth alinement and lack of coordination of compensating curve with condylar indication, and cases exhibiting excessive increases or decreases of the vertical dimension of the denture space; but these factors would naturally be subject to close scrutiny when the diagnosis is made, and the cases checked for compliance or failure to comply with the requirements of good denture work; namely, useful-

ness, good looks and comfort. I shall now take up the treatment of cases in the order given.

Type 1 (*a*) (1). The easiest cases to remedy are those with slight overextension somewhere along the periphery. These are most frequently found in the region of the labial, buccal or lingual frenum. They usually cause the patient a twofold annoyance, because they offer interference to these structures, and the dentures are either dislodged during function or the tissues become severely irritated. These and other instances of peripheral overextension require merely a judicious trimming off of the interfering portions, and a careful polishing.

Type 1 (*a*) (2). Next come the cases showing a slight imperfection in the peripheral adaptation, usually along the posterior border of the maxillary base. When the base is correctly extended, the peripheral adaptation can readily be improved by an addition with tracing stick modeling compound, as in correcting a similar defect in a compound impression. When the desired improvement in the retention is observed, the correction may be made permanent by investing, packing rubber in place of the modeling compound and vulcanizing; or a cast may be poured into the denture, and after this has set, the denture may be separated from the cast and the modeling compound removed, after which the defective area can be heated by applying a small brush flame with a sweeping motion until the vulcanite has become soft enough to be easily molded to the correct form. It is next chilled to harden it again, then buffed and polished. This bit of technic has proved very valuable to us and has often saved both the operator and the patient the work and expense of making new bases. Care should be exercised not to overheat or burn the vulcanite.

Type 1 (*a*) (3). The cases showing slight underextension are usually such as have been overtrimmed in the attempt to overcome nausea. They require additions extending posteriorly to the line denoting the position of tissue flexion. The nausea can be avoided by intensifying the peripheral contact. For this purpose, the denture is thoroughly cleaned and dried, and the additions are built on with the modeling compound tracing stick. This is allowed to reach what is known as the molding stage, when the denture is inserted and pressed against the tissue gently to approximately conform to it. The denture is then removed and placed in cold water to allow the modeling compound to harden. The tissue side of the addition is now glazed by applying a small brush flame, tempered and again inserted. This time it is pressed firmly against the tissue, and it is held thus until the modeling compound hardens. This process can be hastened by injecting ice water against it. It is then removed and carefully inspected. Any overextension is corrected by knife trimming, after which it is checked to see that the desired improvement in the retention has been obtained. The denture is then invested in the base of the flask, so that the corrected area only is exposed. The investment plaster is properly trimmed, a separating medium applied and the investment completed. When the second portion of the investment has become hard, the case is packed, vulcanized and finished as in any repairing.

Type 1 (*b*). Slight imperfections in the occlusion can, as a rule, be easily eliminated by the use of articulating paper to spot the interference, and a bit of judicious grinding with small stones. This may be followed up by the application of some abrasive paste to the masticatory surfaces of the teeth and

allowing the patient to grind the cases by employing the various mandibular movements used in the act of chewing. The latter is recommended only for the elimination of slight errors.

Type 2. This combination type requires the combination treatment. It is, of course, logical to correct the fit of the denture base, before attempting to correct the occlusion.

Type 3. This type, and in fact all others except those under 1 and 2, requires that the cases be mounted on an articulator to permit of a more complete diagnosis than can be made of existing errors with the dentures in the mouth. The cause of malocclusion in artificial dentures showing retrusion of the mandible will be found due to one of two things: failure to register correctly centric jaw relation, or an occlusal change in centric relation due to some change in the supporting tissues or in the temporomandibular joint mechanism. Cases in which errors are not more than 3 mm. in magnitude can be much improved by the application of Hanau's correction technic.[7] Briefly, this consists of registering the positional relations of the dentures by means of the facebow, centric and protrusive jaw relation records, and the employment of these records in the mounting of the dentures and the adjustment of the articulator. This having previously been done for the purpose of diagnosis, the mere modification of the occlusal surfaces and incisal edges of the teeth is required. This, in turn, is again done by using the small stones and abrasive paste. When the mandibular teeth are found in a retrusive relation, or, as the orthodontists would say, in distoclusion, we usually find that this condition causes an increase in the vertical dimensions of the denture space, which is automatically reduced by the grinding done to establish the occlusal balance. As the vertical dimension is decreased, the teeth advance toward the mesial aspect, and often much less grinding is required than was anticipated. The modification previously referred to is an elongation of the mesial slopes of the maxillary teeth and the distal slopes of the mandibular teeth. As far as possible, the sulci, the marginal and transverse ridges and other occlusal characteristics should be retained or re-formed. It is true that major changes in the dimension of the denture space may require subsequent registration and remounting of the mandibular dentures. When the changes in the sagittal plane are not excessive, a single mounting is usually sufficient. When by means of grinding with stones, the articulation is approximately balanced, the finishing touches are performed by milling with the abrasive paste. This, which is also done upon the articulator, should not require more than two or three minutes. The ground surfaces are next polished and the dentures are replaced upon the instrument for a final inspection, after which they are inserted and the patient instructed to return for subsequent adjustments and check-up.

Type 4. When we encounter lateral occlusion in centric relation, the problem of correction becomes more complex. The lateral shift in the position of the mandibular denture increases the overjets on one side, and decreases or obliterates them entirely on the other. It may also show a lateral cusp interference so extensive as to prevent the establishment of balancing contact on the opposing side. The cosmetic value of the dentures may suffer a severe loss if extensive grinding is undertaken. In consequence, this type of case requires perhaps a more exacting study than those previously discussed.

7. Hanau, R. H.: Correction Technic, in Full Denture Prosthesis, Ed. 4, p. 60, 1930.

When checked for compliance with requirements, most of these cases will readily fall into class 5, yet if the change is only moderate, they may be much improved in the following manner: After the dentures have been mounted and checked with articulator records, the teeth on the side toward which the shift has occurred, offering the greatest interference, should be the first to be ground. The buccal slopes on this side of the mandibular teeth are to be reduced both buccally and occlusally, especially those of the buccal cusps, while, on the maxillary teeth, the lingual slopes must be similarly ground. Again, the aim should be to preserve as much tooth structure as possible. It is advisable to do only a small amount of grinding at a time and to check intermittently. As is true in any case, the first objective is to establish proper occlusion in centric relation, next in lateral, and lastly in the protrusive relation. After the grinding is done in centric relation, a check-up should be made to see that the lingual as well as the buccal overjet in the bicuspid molar region is obtained. In the other relations, it is essential to develop a three-point contact. The convexity of the cusp slopes should also be maintained. Finally, the paste grinding is done and the customary check-up and adjustments are in order.

Type 5. In this classification, we may include not only the cases that have undergone excessive changes in positional relations of the dentures, but also such as exhibit improper arch form, tooth alinement, denture space, frontal or sagittal compensating curves, or those which, owing to incorrect overbite or overjet, fail to comply with phonetic or esthetic requirements. It is assumed that they have been mounted and checked.

To facilitate prognosis, it is best that we proceed in a systematic manner to check the various factors previously enumerated. This will help us to determine the treatment best suited to each case.

Whenever a case is judged to be beyond correction by the regrinding method, be it an old or a new case, we should first ascertain whether it will require the resetting of the teeth in the maxillary or the mandibular arch or in both. In many cases, it will be found that the maxillary teeth comply fully with the requirements of good appearance and good speech. If it is seen that the inclination of the compensating curves is relatively in harmony with the articulator condyle guide inclinations, it is but necessary to remove the mandibular teeth from their base, prepare it for resetting the teeth, maintain the accepted dimension of the denture space, reset the teeth in compliance with all requirements and recall the patient for a trying in, at which time the teeth should be closely scrutinized, and when the denture is found to be correct, it is finished in the customary manner, reground and kept under observation for a period of from thirty to ninety days.

Other cases will show that the mandibular teeth are in relatively proper arrangement, but the maxillary teeth were originally set excessively toward the labial aspect or in mesioclusion. If in these cases, the curve of Spee is found to be virtually parallel to the horizontal condyle indication, and the teeth have not been overground, it is a simple matter to reset the maxillary teeth, following a procedure very similar to the one just described for correction of the mandibular denture. If, because of failure to comply with requirements of esthetics, phonetics or balanced articulation, it is found that the teeth of both arches must be reset, the registration of positional relations and the mounting of the old dentures must incorporate the recording of an acceptable denture space and a

proper restoration of facial contour, etc.; after which, the routine procedure of setting the teeth, trying in and completion are carried out. Though this extensive correction may by some be considered impracticable from an economic viewpoint, when it is recalled that once the case is mounted correctly (which, by the way, should consume but from fifteen to thirty minutes), and, as has been noted, the bases, on examination, have met the retention test, we save the time that would ordinarily be given to the taking of impressions and making of casts and baseplates, and have the additional advantages of registering positional relations with bases that the patient has been wearing and in consequence is thoroughly familiar with, thus avoiding certain hazards usually associated with the recording of these relations with new bases and attached contour occlusion rims.

The position of the teeth, the arch form and other related conditions, though judged incorrect, serve as reference marks or points of departure, and, in consequence, not only a very appreciable saving of time is effected, but other distinct advantages accrue.

Type 6. When dentures are constructed for patients presenting a marked prognathism, it is advisable first of all to look well into the etiology and to ascertain whether this condition is normal to the patient. Most cases of acquired prognathism due to the early loss of the permanent maxillary first molars and resultant checked development of the maxilla are, when the patient becomes edentulous, quite like the normally prognathous case. When the prognathic condition is acquired after maturity, it differs materially from the normal in that the condition is not due to disturbance in the biologic development, but represents merely a changed position of the mandible brought about by the loss of the structural support normally furnished by the presence of the natural teeth.

The changes to be anticipated and the treatment to be accorded being quite different, it will be best to discuss them separately.

1. When the normally prognathous cases become edentulous, the ridge relation is usually further aggravated by the resorption of the labial portion of the maxillary plate of bone and the loss of a certain portion of the occlusal area of both ridges. It is customary in these cases to attempt not only to restore lost facial dimensions, but also to improve on nature as much as skill and good judgment will permit. Modifications of technic pertaining to contour and arch formation, as well as the employment of the crossbite arrangement of teeth, is at times resorted to. Yet all this does not prevent the usual changes from taking place. The most frequent phenomena to be observed is a drifting of the mandibular teeth into mesioversion. This is due primarily to changes in the supporting tissues and the settling of the dentures. These two conditions constitute virtually an increase in the vertical dimension of the denture space. The better solution of this kind of problem is compensation by addition to the bulk of one or both dentures, which may be accomplished by a relining. If the retention of the maxillary denture is satisfactory, it may be possible to effect the correction by relining the mandibular denture only. It will be necessary to see that the addition is sufficient not only to compensate fully for the change in the denture space, but also to transpose the mandibular arch so as to correct the occlusion of the teeth. The latter is done by registering the positional relations after the relining impression has been made; pouring of casts, mounting on the articulator, adapting a layer of wax to

the new mandibular cast and setting the dentures into this softened wax in such a manner as to bring the teeth into centric occlusion; checking the articulation in lateral and protrusive relation, waxing up, trying in and finishing in the usual manner. Because regrinding of itself would but reduce the vertical bulk of the denture and entail a further closure of the jaws, which, in turn, would cause the lower teeth to project still farther anteriorly, it is rarely ever advisable to attempt it.

When both denture bases show fair or good retention, the correction may be made without resorting to the relining method; as follows: Casts are poured into the denture bases direct. After these are hardened, they are pried loose from the dentures. A set of positional relation records is obtained (facebow, centric and protrusive.) The desired increase for the vertical dimension is registered with the centric relation record. The case is now mounted and the articulator adjusted, and the teeth are carefully removed from the mandibular denture. Sufficient of the vulcanite is removed to allow resetting of the teeth, incorporating the vertical increase. They are tried in, and when found acceptable, they are finished as usual.

2. These cases, when first studied, appear to be truly prognathous, but later will appear to have been acquired after maturity, and therefore but assuming this relation because of lack of support and balance. The condition has been acquired so gradually and has existed in many cases for so long a period as to have been accepted by the patient as normal. The musculature has accustomed itself to the present state and, until full dentures are placed, no conscious or unconscious attempt is made by nature to correct this condition. It is but a drifting process that becomes progressively worse. It is these cases that cause difficulty for the conscientious operator, irrespective of the methods of technic and appliances used in the construction of dentures. Many times, it is virtually impossible to register true centric relation of the mandible. In consequence, only after the dentures have been delivered to the patient do we learn that we have failed in this respect. The actual wearing of the dentures seems to do what skill, appliances and patience have not been able to accomplish; namely, to assist nature in making the adjustment in the joint mechanism. The patient whom we sent out with what we considered dentures in perfect relation and balance returns in a day, a week or a month, with a severe case of malocclusion. The treatment of this type, depending on the magnitude of error present, can be handled very much as those of Type 3.

Type 7. In checking the etiology of these cases, we usually find that these conditions are due either to a more extensive settling of the dentures posteriorly than anteriorly or to the fact that, during construction, the influence of condylar guidance has been ignored and the teeth set in defiance of rather than in compliance with the laws of articulation. True, one can make a casual examination with the dentures in the mouth; but again I wish to emphasize that a more comprehensive diagnosis and prognosis are possible if the case is mounted in the prescribed manner. It is not practical to attempt to correct the incisal overbite by grinding, as this procedure would severely mutilate the anterior teeth. It is always best to reset one or the other arch and affect the correction during the resetting, giving due consideration to the esthetic, phonetic and masticatory requirements, one's judgment dictating which arch is to be reset. It may be possible to overcome the difficulty by just setting the

anterior teeth over, but as this makes refacing necessary, and investing and packing more difficult, it is easier to reset the entire arch. Lack of molar contact in lateral relation may have been brought about by injudicious grinding. Particularly is this true with the lingual cusp of the maxillary molars. To overcome this, it is sometimes necessary to deepen the grooves and sulci before resetting the teeth.

To one familiar with the laws of articulation, it becomes immediately evident that in setting teeth in opposition to models of natural teeth, or in occlusion with artificial teeth firmly fixed in a denture base, these circumstances force on the operator the acceptance of the sagittal and lateral curves as presented. He consequently modifies his technic accordingly. Desirous of achieving the best possible result, he is quite naturally interested in methods that may aid him in accomplishing his purpose with reasonable ease and dispatch. In the treatment of this type of case, the objective is to establish the previously missing contacts of the posterior teeth and avoid interference in the anterior. It will greatly simplify matters to begin by setting the second molars first, checking their occlusion in right and left lateral as well as the protrusive relation to see that the necessary contacts for articulation are established. This will require, aside from the grinding previously referred to, that the incisal guidance be so adjusted as to facilitate this development. When this has been accomplished, the other teeth are set in sequence, from the first molars to the incisors, the contacts desired being checked as were those of the second molars. Lastly, the incisal overbite is established in accordance with the accepted incisal guidance. When, for either esthetic or phonetic reasons, it is now considered that the overbite should be either increased or decreased, this can be done without disturbing the set-up of the posterior teeth by increasing or decreasing the overjet. The foregoing method of treatment may be applied to any case that requires resetting because of a lack of coordination between the condylar guidance and the compensating curves. In these cases, a trying in is also advised; after which, routine procedure is in order.

Type 8. The treatment to be accorded temporary dentures showing loss of retention will vary according to the conditions disclosed by careful examination. It may be a rerimming, a relining or a rebasing, according to indications.

W. H. Wright has recently called attention to the fact that we have not made sufficient distinction between such corrective measures when referring to them. It is well for us to pause to consider this, that we may avoid similar errors in the future and, in consequence, help to lessen the confusion that exists.

A rerimming of dentures is indicated when diagnosis reveals a lack of peripheral seal, yet the denture showed by test that the stability was fair; an indication that surface adaptation to the stress-bearing area was still good. In order to preserve the positional relation of the denture, it is advisable that the periphery be rerimmed sectionally. For example, for maxillary dentures, the posterior border may constitute the first section. Then the balance on either side of the median line may be treated as two additional sections. The edges of the flanges should be neatly prepared to permit making a clean and precise line joint and all undercuts should also be removed in the trimming to avoid subsequent fracture of the cast. This should be done before the modeling compound tracing is applied. It is advisable to prepare and correct one

section at a time. After the first section is judged to be satisfactorily corrected, the other sections are treated in a similar manner. As previously noted, there is less chance for disturbing the position of the denture when the correction is done by sections.

In applying the tracing stick to the periphery, it is well to add a slight surplus. This will allow for a more perfect adaptation. After application, the tracing is tempered. The denture is then seated approximately, with gentle pressure; which helps to effect a more or less uniform distribution of the material. The denture is taken out of the mouth, the compound addition thoroughly softened by application of a small brush flame and again tempered, and the denture is once more seated. This time, it is pressed firmly into position, after which the patient is asked to occlude the teeth and to move the lips and cheeks, thus functionally adapting the impression material and more or less automatically establishing a peripheral seal. While the patient maintains the muscular tension and holds the teeth in occlusion, the operator injects ice water to hasten the hardening of the modeling compound; after which the denture is removed and the other section treated in like manner.

When correction is completed and checked, the surplus material is trimmed off; and the denture is boxed in as an impression and a cast poured into it. It is then invested in the usual manner. Extreme care should be exercised that no distortion occurs during vulcanization and finishing. In cases of mandibular dentures, the method differs only in that the rerimming may be done in two or four sections. Even when only a rerim is undertaken in mandibular dentures, it virtually resolves itself into a relining, because the peripheral masses flow toward each other in the center of the base, where they fuse together. It should be noted that after the rerim impressions have been obtained, a check-up should be made on the occlusion. After vulcanization, this check should be repeated, and some slight grinding should be done to offset any minor interference.

Relining a denture differs from rebasing in that it constitutes merely a surface addition to the existing denture base. To rebase a denture means the construction of an entirely new base to which, by means of transposition, the dental arch which is separated from its original base is attached. A lining for a denture may be made of plaster of Paris, wax, guttapercha, special cement preparation or modeling compound. All of the foregoing materials have been and are being used for relining dentures. As in regular impression taking, we find that plaster of Paris and modeling compound are most commonly used. A lining of either of these materials, when properly employed, does improve the surface adaptation of dentures, but, because of their nature, these materials are of but transient value and must in turn be replaced by vulcanite or some other more nearly permanent material. Whenever by replacing the lining of the impression material with one of vulcanite, the original base is retained, we may properly say that we have relined the denture.

DIFFICULTIES ENCOUNTERED IN THE PROCESS OF RELINING DENTURES

It has been my observation that most attempts to reline maxillary dentures result in some disturbance of the positional relations. We must not overlook the fact that these transpositions may be three dimensional. Then, too, we find that, owing to the resorptive changes that have been going on, there has already occurred a disturbance in the positional relations. Therefore, it resolves itself not so much

into preserving them, but rather into re-establishing them. Quite often, when dealing with patients possessing a marked ability to tolerate misfits, we have labored under the impression that technically we were about letter perfect, only to discover that we were far from it. All of these things, coupled with the unequal distribution and occasional excessive bulk found to exist in the impression relining, prompt me to state that, while it will serve well to improve adaptation to the supporting tissues, and equally well to record anew positional relations in the making of new casts and bases, it is seldom that a maxillary relining can be effectively reproduced in vulcanite without resorting to a new base. Thus, we are confronted with the combination technic of relining-rebasing.

Having cited some of the difficulties that may be encountered, I shall now give a brief outline of the divisions of the relining technic.

1. Preparation of the denture base to receive the impression material. This, as far as it applies to the periphery, is quite like that described for rerimming. In addition, it is necessary to be positive about eliminating overextension. Any portion of the vault area that is found to bear excessively on the tissues should be removed to avoid undue pressure and possible incorrect tissue placement during impression taking.

2. Preparation and application of the impression material to the denture base. When plaster or hydroplastic cement is used, it requires merely that the material be brought to proper consistency, conveyed to and applied to the previously dried inner surface of the denture. The insertion, seating of the denture and manipulation of lips, cheeks and adjacent muscles, permitting the teeth to occlude during the process, are also helpful. When compound is used, it is again advised that the sectional method be employed.

3. Removal from the mouth, careful inspection, trimming off of surplus impression material (replacing and testing the retention and positional relation, if permissible, as in compound impressions), boxing in, pouring of the cast, investing, separation, packing, vulcanizing and finishing.

4. The replacement of the dentures, spotting interference with the aid of articulating paper, and stone and paste grinding.

These steps are fundamental and, in the main, present no great obstacle other than the one so often alluded to, the control or maintenance of positional relations during the process. If the bulk thus added to the denture is not judged excessive, the mere replacement of the impression material by vulcanite will suffice. Another modification that may be employed when the vault portion has become unduly bulky involves the cutting out of the vault portion after the cast has hardened and replacing it by one of lesser thickness.

Relining mandibular dentures is also accompanied by certain hazards, among them the bugaboo of positional relations. Merely to reline a lower denture is in fact quite a simple procedure, but to maintain the proper relations, to avoid penetrating the impression material by some portion of the vulcanite base and to retain the acceptable vertical dimension of the denture space, just these three procedures alone, can keep the operator well occupied.

One of the main causes of trouble, as far as the position of the denture and its proper maintenance is concerned, is the denture's lingual flange. In using the denture as an impression tray, we naturally require that the flange be of sufficient length to adequately support and

convey the impression material; yet the very presence of the flange often offers interference to the closure of the jaws in centric relation, forcing the mandible to protrude in order to clear it. Particularly is this true when an attempt is made to fully rebase, as with compound according to the technic described some years ago by R. W. Tench.[8]

To overcome this difficulty, and at the same time to maintain an accepted vertical dimension of the denture space, we have for some years employed and advocated the sectional method of relining mandibular dentures. If the existing denture space is found acceptable, we proceed immediately with the preparation of the base for the reception of the impression material. If it is desirable, the vertical dimension of the denture space is increased by an initial relining of sufficient bulk to provide the increase; after which, a second lining is placed, at which time the functional impression technic is used.

ROUTINE PROCEDURE FOR SECTIONAL MANDIBULAR RELINING

Preparation for relining is made on one half the denture at a time. First, 1 mm. of vulcanite is reamed out of the center or ridge area. Then, all labial, buccal and lingual undercuts are removed; and, lastly, the flange periphery is cut down so as to be slightly underextended and trimmed and squared to permit of forming a neat line joint with the new vulcanite. The untrimmed side, along with the occlusion of the teeth, is depended on to aid in guiding the denture to place, and to maintain the denture space as accepted during the taking of the impression. The modeling compound is now attached to the prepared surface and so distributed as to place some slight surplus in the peripheral region. It is now glazed with the small brush flame and tempered, and the denture carried to place. The patient is instructed to relax all the muscles of the face and mouth, after which he is told to close the jaws, to suck and to swallow, repeating these actions two or three times. He is asked to keep the teeth in occlusion and maintain muscular tension until the compound has hardened, which is hastened by injections of ice water. The denture is now removed, the impression carefully inspected and any overextensions and excess is trimmed off. It is again placed in the mouth, and centric occlusion is checked and the positional relation considered. If no error is detected and no discomfort is sensed by the patient on the relined side, the procedure is repeated on the other half.

After the second side has been relined and trimmed, the denture is tested for stability. Then, by slight tracing stick additions about the basal outline of the retromolar area, the peripheral seal is completed. The latter is not always required, yet usually improves the retention materially. A final trimming is done to insure elimination of overextension, and once more tests are made to see that the requirements of stability, resistance to displacement forces and comfort have been complied with.

It is with the relined lower dentures, in which we have thus perfected the surface adaptation and improved the retention, that we quite often accept the patient's very agreeable verdict that all is well. We proceed to finish the case and deliver it to the patient. Both he and the operator are enthusiastic over the result obtained; but after from twenty-four to seventy-two hours, the patient returns complaining of a sore mouth and, as he puts it, a somewhat lessened reten-

8. Clapp, G. W., and Tench, R. W.: Professional Denture Service, New York: Dentists' Supply Company, 1921.

tion. What is it that has taken place? What is it that, after all this careful checking, produces such ill-effects? The most plausible answer I have to offer is that the patient, during the relining and checking process, had habitually closed his jaws in a slightly protruded position. Owing to the resorption of tissue and consequent looseness of the dentures, he formed the habit and tolerated the condition; yet now that the fit of the base had been improved, he soon learned that he could not perform the usual functions without experiencing great discomfort. Have we failed? Yes; but only in a degree. Why? Because we failed to follow up the improvement in the base of the denture by the application of the correction technic to the articulation. I am convinced that all cases, whether they be rerimmed, relined or rebased, should receive this treatment.

Type 9. These cases, in which esthetic values and articulation seem to be not only acceptable, but also, in many cases, so pleasing to the patient that they request that the arrangement be preserved or duplicated, can be handled most easily by the rebasing method.

As already mentioned, this signifies the placing of the arch upon a new base. New bases may be acquired either by using the old denture as a tray, employing the relining technic just described or by taking new impressions, making baseplates and, with the aid of these, obtaining registration of the positional relations of the jaws. When the new bases are mounted, the arches can be set *in toto* on them; and the cases tried in and finished in the usual manner. It is sometimes difficult to obtain a good relining impression with a denture that is markedly underextended. It can be done by first using modeling compound to extend the base before relining. This applies equally well to either maxillary or mandibular dentures. It is quite obvious that here the correction technic should be employed to insure best results.

Type 10. When tests prove that the denture bases are not only well fitting but also comfortable to the patient, but the prime fault lies with improper tooth selection and arrangement, we have, of all the cases referred to, the simplest type to treat. All that is required is the recording of the acceptable denture space, modification of facial contour, registration of the positional relations of the jaws, mounting of the dentures on the articulator, removal of the old teeth from the denture bases, the selection and setting of the new teeth, the trying in, etc.

CONCLUSION

Let me again assure you that this and the other methods that I have cited are possessed of distinct value to both the operator and the patient. There are some details that I have failed to touch on, knowing that most of you are familiar with the fundamentals of full denture prosthesis.

DISCUSSION

Felix A. French, Ottawa, Canada: The subject under discussion is of vital interest to anyone building artificial dentures and deals with a phase of prosthesis on which little is to be found in the literature. The keynote of Dr. Schlosser's paper is embodied in this statement: "In the main, success in full denture construction is dependent on the establishment and the maintenance of retention and balanced occlusion." Much attention has been given to obtaining accurate base adaptation, balanced occlusion and a pleasing appearance, but as we are dealing with living tissue, we have one factor which is subject to change, and changes in the seating areas may alter any or all of the other three to such an extent as to require correction. Dr. Schlosser first stresses the point that a careful diagnosis should be made before any corrective measures are undertaken. He differentiates between errors in base adaptation and errors

in occlusion and proceeds to classify in such logical order the various conditions or combinations of errors that may be encountered that anyone conversant with them should have little difficulty in arriving at a correct diagnosis. He also states briefly corrective measures applicable in each instance, and refers to the difficulty of altering base adaptation without disturbing centric occlusion, stressing the importance of guarding against such an error. He touches on such factors as esthetics, phonetics, alinement, form and the harmonious arrangement that must exist between the incisal guidance, compensating curve, cusp height and the condylar guidance in order to have balanced occlusion.

A REVIEW OF POSTGRADUATE EDUCATION IN ORTHODONTIA*

By EARL G. JONES, D.D.S., Columbus, Ohio

POSTGRADUATE training in its broader sense has been the initial means of approach to specialization regardless of the field. Postgraduate education is defined literally as "a term of study or training in a subject (not necessarily leading to a degree) following graduation." An analysis of the definition shows, first, that a term is a period of indefinite duration. It may be weeks, months, or years. Secondly, the course may be entirely didactic or mechanical, or, in some instances, it may be both. Thirdly, postgraduate work does not necessarily lead to a degree. True, degrees are given by some of the privately owned schools, but these have no value or rating in universities or colleges.

The postgraduate course is often confused with the graduate. It has as a prerequisite a degree in dentistry as has graduate study, but the student entering on a graduate course in orthodontia matriculates in the graduate school of the university rather than the college of dentistry. This course is never less than one school year in duration and may be for two or more. The student is then eligible for a degree of master of science or doctor of science in the graduate school, this depending on the amount of time spent and knowledge attained.

Although my subject is postgraduate education, I cannot refrain from speaking of the advantages of graduate courses in orthodontia.

There is every indication that the most advantageous time to pursue specialized training is immediately after graduation. A student who has completed six years of science and dentistry such as most dental schools are offering is in a much better position to make a decision as to specialization than is the man who graduated a few years ago from a three or four year course in dentistry. The increased time spent in dental education permits him to have additional time in clinical work. He therefore has as much dental experience by the time of his graduation as many men formerly had in two or three years of practice. The continuation of habits of study makes for more studious application than is probable in a graduate who has been out of school two or three years.

The attitude of the student of today

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is entirely different from that of students of a few years ago. A man who has had two years predental education has acquired methods of study which, by the time he has reached his junior year, cause him to assume somewhat the attitude of the postgraduate student of previous years. The student no longer picks out the soft spots in an effort to "get by," but seeks out the teacher who can give him the most enlightenment on the subject at hand.

The student of today is decidedly analytic. He demands that he be shown. The veil of mystery which has for years shrouded orthodontia and has proved so discouraging to many has no terror for the present-day student. He is well fortified with a knowledge of the biologic sciences and his ability to master the mechanical phases of crown and bridge procedures and prosthetic work has been proved. He correctly assumes, therefore, that a knowledge of the science of orthodontia is attainable, that it has problems, naturally, the same as other phases of dentistry, but not so momentous as some of his predecessors would lead him to believe.

It was natural that those entering upon the study of orthodontia with but a three year course in dentistry, which, in many instances, was not very strong in the biologic sciences, should be carefully selected and trained. It is probable that these early teachers sensed the need of emphasizing the importance of their undertaking and therefore stressed the difficulty of the subject unduly.

Prior to the beginning of the twentieth century, the science of orthodontics was not so seriously considered. It is interesting to find in John Hunter's "History of the Human Teeth," written in 1778, two chapters on irregularities of the teeth. The following paragraph shows the trend of thought of that period:

> The means of making pressure I shall only briefly describe, as they will greatly vary according to circumstances, so considerably indeed that scarcely two cases are to be treated alike and in general the dentists are tolerably well acquainted with the methods. In general it is done with ligatures or plates of silver. The ligatures answer best when it is only required to bring two teeth closer together which are pretty much in the circle. The trouble attending this is but trifling, as it is only that of having them tied once a week or fortnight.

It is quite evident that treatment was considered largely in the light of mechanical intervention.

The first serious thought on orthodontic education came with the organization of Edward H. Angle's school of postgraduate instruction in orthodontia, about 1900. He says, in part[1]:

> In 1880 I had become very much interested in Orthodontia and I came to believe that some time orthodontia would be practiced as a specialty for it seemed to me that its importance entitled it to a closer study and application. . . .
>
> In 1896 I advocated its teaching and practice as a specialty, in a paper read before the Western Pennsylvania Dental Association.
>
> In 1899 at the meeting of the National Dental Association at Niagara Falls, a few young men became very much interested in Angle and his idea of orthodontia. As a result of the interest awakened four young men Dr. Thomas B. Mercer, Henry E. Lindas, Milton T. Watson and Herbert A. Pullen went to St. Louis and spent about three weeks with Dr. Angle in his office. This was the very humble beginning of the Angle School of Orthodontia.

Since that time, many schools have offered postgraduate instruction. It is commendable that the most of these schools have exercised great care in the selection of their teachers and the students that have matriculated. It can also be said that, for the most part, the schedule of study and training was such that a high

1. Weinberger, B. W.: Orthodontics: Historical Review of Its Origin and Evolution, St. Louis: C. V. Mosby Company, 1926, Vol. 2.

standard was maintained for the graduates. These schools have made a valuable contribution to orthodontic education.

As has been stated, orthodontic conceptions were at first largely mechanical. Courses of from three to six weeks were spent in instruction regarding technic and appliances, with a few lectures on etiology and diagnosis. These early students deserve much credit for their attitude and perseverance, for despite their meager training, orthodontia has progressed; and they have grown with the science, through their reading and attendance at orthodontic meetings, gaining the knowledge which is necessary to the successful practice of orthodontia today. They have emerged from the purely mechanical aspects of orthodontia to the biologic point of view, scarcely realizing that they have been constant students for many years.

The graduate of today is placed in an entirely different position. He has a knowledge of the fundamental sciences of dentistry which, after all, are the basic sciences of orthodontia. He is also a skilled technician. His problem is the practical application of orthodontic principles, which should be supervised over a sufficient period of time to demonstrate the problems of treatment. Six weeks of concentrated study as outlined by most postgraduate schools affords eight hours a day or forty-eight hours a week, which is equivalent to three hours a week for three school years of thirty-two weeks. This is ample time for the study of theory and technic. The criticism commonly heard is that insufficient time elapses to demonstrate the problem involved in the correction of malocclusion and facial deformity.

Much criticism is heard concerning dental education. We who are teachers know of the shortcomings of dental education and are constantly striving to better conditions. Criticism is often based upon hearsay or a personal opinion which is without foundation.

In order to better understand the transition which is taking place in orthodontic education, it might be well to note the change in undergraduate dental study.

The first school of dentistry in America was opened as the Baltimore College of Dental Surgery, in 1840. In 1867, the dental department of Harvard University was organized in close association with the medical department. This was the first time that dentistry had been given recognition and had occupied a place with medicine in health service. At this time, only sixty-five years ago, there were only nine colleges of dentistry in America.

The courses were usually extended through two terms of from three to five months, a total of approximately sixteen weeks. The requirement for a degree of doctor of dental surgery was, in 1884, two terms of five months each in separate calendar years. In 1900, there were fifty-seven dental schools in the United States. This number has slowly decreased with the advancement of educational standards until there are now only thirty-eight.

In 1900, when the first postgraduate school in orthodontia was organized, the minimum entrance requirements in some schools was the equivalent of the requirements for entrance to high schools. In others, from one to two years of high school work was required. From 1891 to 1916, a three-year course of study based upon a minimum entrance requirement of a high school diploma or its equivalent was the accepted curricular standard. In 1917-1918, a four-year course was offered. A few years later, several colleges established a predental requirement of one year of academic work. In the school year 1926-1927, the Dental Educational Council made one year of academic work compulsory for all candidates for a degree in dentistry.

In 1921, under the direction of William J. Gies, the Carnegie Foundation for the Advancement of Teaching undertook an extensive investigation of dental education in the United States and Canada. This was, I believe, one of the greatest steps in dental education that have ever been made; for out of the recommendations of that survey has come the standardization of many curriculums and the establishment of predental academic educational requirements of two or three years.

The report, issued in 1926, criticized the dental curriculm and recommended the adoption of at least two years of academic predental work and three years of dentistry for a degree and one year of optional graduate training for specialists.

It was natural that such a recommendation should create considerable discussion and result in the variance of opinion which ultimately led to the three types of schedules, as follows:

1. Those (twenty-one) based on one year of academic and four years of dental education, i. e., the 1-4 plan.

2. The 2-3 plan, i. e., two years of predental and three years of dental training. There are five of these schools. Usually, the second predental year under this plan embodies several subjects related closely to the dental curriculum and which may be found in the final year of the dental course of the 1-4 plan.

3. The 2-4 plan, i. e., two years predental work (following closely the first two years schedule of the arts college) and four years of dental education. At present, there are sixteen colleges in the United States and Canada on this basis. Next fall, at least one school will be on a schedule of three years of predental and four years of dental training.

Those who are active in dental education are cognizant of the Committee on the Survey of the Dental Curriculum of the American Association of Dental Schools, under the support of the Carnegie Corporation, which commenced its study in the summer of 1931. This group has undertaken a study of dental education which may extend over three or four years.

The survey is unique in that it does not attempt to appraise or evaluate the curriculums now offered by dental schools. It is not made primarily to discover what the dentist is now actually doing, but rather to determine what he should do.

The survey looks not merely to the values of present practice: it rather anticipates a greatly improved ministration to dental health needs of the future. Its purpose, stated in the words of L. E. Blauch, the executive secretary, are threefold:

> The first phase is to obtain a clear and detailed view of the dental health needs to which dentistry must minister as well as to secure certain additional information upon which the professional practice of dentistry must rest.
>
> The second phase of the plan is to secure the cooperation of the teachers in the dental schools, to assist in determining the content of the curriculum.
>
> The third phase will be to arrange the content in a curriculum for the use of the dental faculties.

Of 168 replies from laymen regarding the dental health needs of the public, practically all stated that care of children's teeth and correction of irregularities were most important. This is quite significant coming as it does from those entirely outside the field of health service.

It is a challenge to the dental profession to increase its efforts in the care of children's teeth; which, after all, is the greatest field of preventive dentistry.

I am extremely interested in the work of the committee on the survey as it is undertaking an inquiry into the problems

of orthodontic needs and instruction. More than 500 questionnaires have been sent out to the dental profession, as well as others to the deans of the dental colleges. These inquiries are definitely pertinent to the needs and the teaching problems of orthodontic education.

It is difficult to convince the American Association of Dental Schools of the importance of any one type of specialization over another, but when the inquiry and recommendations come through the committee of that association, it has value. Dental curriculums of the various dental colleges are being generally revised, but many schools are waiting for a report of the survey before making a further adjustment of schedules of study.

From the foregoing review of schedules of dental education, it will be seen that the science of dentistry has been a recognized study for only about sixty years, the greatest strides having been made in the last fifteen years. Orthodontic education has been materially benefited in the study of the biologic sciences by the increased stress placed on these sciences in the undergraduate dental curriculum. Research, which has been the expressed need of orthodontia, is being carried out in the dental colleges under the auspices of the dental research department. Their work on anatomy, nutrition, physiology and pathology can be interpreted definitely to our advantage. Research on definite orthodontic problems could, and, in all probability, would, be made possible if adequate funds were available for such work.

Insufficient salaries for teachers have been the greatest drawback to teaching and proper clinical supervision with which orthodontic education has had to deal. I doubt that there is a single school that could not find time in its schedule of study for twice as much orthodontia if the teachers would donate additional time for instruction.

Clinical instruction is also handicapped by the fact that, with few exceptions, we have no full-time instructors. It is difficult to leave one's office where everything is conveniently arranged and enter enthusiastically on college work, to which less than one third of one's time is devoted, and in which working facilities are not ideal. I say it is exceedingly hard to keep up one's interest.

I am not in favor of completing any phase of specialized training in undergraduate study. I am definitely in favor of giving a sufficiently strong course to enable the student to appreciate at least some of the minor problems of orthodontic practice. Training carried through the junior and senior years based upon the fundamental biologic sciences as taught by teachers qualified in those branches can be made strong enough to give a student a conception of the basic principles of orthodontia. A constructive criticism might be that we teachers of orthodontics do not appreciate that, in this enlarged plan of dental education, the subjects of biology have been amply taught; the biologic sciences of orthodontia are the biologic sciences of dentistry. It is a waste of time to review these courses except to show their relation to orthodontics, and part of this can be done by the teachers of the various sciences if their attention is directed to the application of their subject to orthodontia.

As for technic, a much stronger course can be formulated.

A casual survey of the technic report published in March, 1931, by the American Association of Dental Schools, compiled by the committee on the survey of dental technic, shows some interesting data: number schools cataloged, 33; number schools reporting orthodontic

technic, 20; number schools failing to report, 13; average hours of twenty schools, 64; average school year in weeks, 32.

This means two hours a week for one year. The average amount of technic required has three main phases: (1) carving of plaster models; (2) making of McGill bands and alinement appliance and (3) making either a lingual appliance or a retainer.

Approximtely ten weeks is required for each.

Following are schedules of orthodontic technic in three different schools taken from this survey.

School No. 1

Junior Year: Hours 128

1. Plaster blocks to specified measurements.
2. Compound impressions: poured in stone and plaster.
3. Plaster impressions.
4. Carving maxillary and mandibular casts in plaster.
5. Technic cast in stone: molar bands; labial appliances; soldering technic.

School No. 2

Third Year: Hours 32

1. Impressions and full maxillary and mandibular models, correctly trimmed.
2. Impressions and models for molar band technic.
3. Construction of two molar bands, fitted to model, with buccal and lingual tubes attached.
4. Construction of lingual arch with auxiliary springs and lock spring attached.
5. Construction of labial arch with stop spring soldered.
6. Construction of two pinched bands with soldered attachments. All soldering to be done with hard solder.

School No. 3

Third Year: Hours 33

1. One set of models of fellow students, taken in compound and trimmed according to Angle and Dewey.
2. Soldering short pieces of wire to main wire, half inch apart, one at a time, without destroying unions already made.
3. One regulating appliance made on metal model of the mouth of a fellow student, consisting of bands with attachments cemented on the teeth of the model, with lingual and labial arch wires contoured to fit.
4. One Angle or Gilmer splint, using models of mouth of fellow student.
5. Vulcanite splint, using models of mouth of fellow student.
6. Splints showing emergency wiring.

The survey shows conclusively that ample time is given, but is wasted on nonessential bits of technic. Plaster models such as are required in most colleges can be included in the plaster work during the freshman year, and McGill bands represent but phases of crown and bridge soldering.

I would not discredit for one moment the several short term postgraduate courses. They have filled an important rôle in orthodontic education: they have been the means whereby most of us have gained a foothold in the science of orthodontia.

A new day is dawning in dental education. With the increase of time given to dental education, more training can be given in orthodontia. Because of the improved educational standards of dentistry, the better types of students are being attracted. It seems quite possible that, in this enlarged plan of education, at least three hours a week for three years may be found without curtailing any of the undergraduate curriculum for orthodontia as has been suggested. This, as has been previously stated, is the total accepted time for postgraduate courses. It certainly should suffice for students who are admittedly better educated in the fundamental sciences. If every dental graduate had sufficient knowledge to care for the minor cases of orthodontia, there would be fewer laboratory made appliances and better cooperation on the part of the general practitioner.

As for those wishing to devote their entire time to the practice of orthodontia or to teaching, it seems only reasonable to expect that they should spend at least

one year in the definite study of the subject. Several of our universities are now making it possible for young men to teach part time in the dental clinic while pursuing a graduate course in orthodontia. Our colleges are best equipped for teaching. The men of unquestionable ability and authority who make up our faculties are giving instruction in the several fundamental sciences. I have always found them eager and ready to cooperate. With the services of such men, the university environment and the facilities for research, it is only natural that graduate training for the specialist is the ideal step of progress.

Just as dentistry has progressed from private schools to become integral parts of our universities, so will orthodontia advance from short term courses of postgraduate schools to graduate courses of the graduate college.

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DISCUSSION

C. Angus Kennedy, Toronto, Canada: Dr. Jones thinks that, under the present educational conditions, the proper time for a student to enter a specialty is immediately after graduation. In doing this, the student has the benefit of the experience of the infirmary and the teaching staff for a year or two longer, but he always has the consciousness that he has the staff at his back and he can refer any and all questions to them. On the other hand, the man who has been in general practice for three or four years or more has more experience, with judgments based on his practical experience, and would be better able to correlate general dentistry to the specialty of orthodontia. In this case, the student has only himself to fall back on and his experiences and his failures will make him better fitted to take up the study of any specialty. As this section of the American Dental Association has developed today more as orthodontia for the general practitioner, I think it would be of interest to know what we in Ontario are doing to help the general practitioner in this study. We have at the dental department of the University of Toronto a postgraduate course taking one year whole time or two years half time in research work in which the student will take the major subject of orthodontia and a minor subject of his own choosing and shall hand in a thesis at the end of his term which leads to a degree of bachelor of science in dentistry, B.Sc. (Dent.). This degree may be taken in any subject that the student chooses. Another feature of our postgraduate course is the consultation service given by the dental department. This means that a general practitioner who has a case in orthodontia on which he would like to have some information sends in models and fills out a questionnaire and forwards them to the faculty for advice. This advice is given by letter and also by drawings of the appliance or appliances needed for the case. The dental faculty assists the general practitioner in Ontario by giving "refresher" courses to a class of between ten and twenty. A graduate comes in to our faculty for a week's duration in which he will have both lecture and technic courses, he himself doing the work of making his appliances. This has proved very satisfactory both to the faculty and to the general practitioner.

A SPECIFIC TYPE OF SYSTEMIC DISEASE THAT MAY FOLLOW DENTAL FOCAL INFECTION*

By J. M. GULAS, D.D.S., Milwaukee, Wis.

I HAVE come before this group not with a new finding in research but to present briefly a problem that confronts the teacher of pathology in the dental field.

As a student of one of our dental schools, I approached my work as do most ordinary students, with the preconceived notion that the most intricate truths of my micro-organismal life, the immunity mechanism and resistance, the physiologic inflammatory response and a certain method of cure, would all be imparted to me by the learned professors on the faculty roster. I had the good fortune to study the work under the direction of a professor who was ready to admit, as an honest and humble student of pathology, man's incomprehension of the great natural forces at work about us. This incompetence of man and his inability, up to the present time, to understand thoroughly the mode of operation of the physical, chemical and biologic reactions at play in the pathologic processes has been forcibly brought to my attention during my brief experience as an instructor in the subject of pathology, both by the inadvertent questioning of the intelligent student and by the asinine grueling at the hands of the class dunce.

This should in no manner influence the earnest student of dental pathology. There is so much that is known about bacteria, infection and the pathologic tissue changes associated with disease that the study of these subjects affords us an all-consuming task. One of the things that has impressed me most unfavorably is the lack of fundamental knowledge of systemic disease among the general practitioners of dentistry. This applies both to those entities that fall into the class of general diseases that should invariably be in the hands of the medical man, but that do produce regional lesions in the oral cavity which may lead the patient to the dentist's office originally; and to those diseases that arise from foci of infection that may be situated in the alveolar process and are part of the pathologic picture of dental disease. We hear a great deal at the present time of medical training for the dentist. There are advocates of continuing the present method of dental education and there are those who want dentistry "elevated to the level of a profession" and made a specialty of medicine. While this debate is going on, we the teachers of general and special pathology cannot pass by the opportunity to improve the knowledge of the dental student and, much more important, of the thousands of dental practitioners who are out of contact with the educational institutions, regarding disease processes. The men who would win for us a place of esteem with our medical brethren by a single graceful gesture forget that the knowl-

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edge of our subject and the ability to apply it will breed more respect and esteem in the minds of the medical profession than any amount of self-exaltation.

The dental pathologist owes it to the profession to reorganize in a better and more detailed fashion the available knowledge regarding separate disease processes that are closely associated with dental disease or produced by dental infection. Of these, the production of systemic disease from foci of infection and the type of systemic lesion that may be produced should be given first consideration. The medical man has for several years consulted the dentist about these cases and concedes to him an opportunity to become part of the agency of health administration. From my short experience of four years in a general clinical laboratory, I have only this to say of the average dental practitioner: He is wofully lacking in his knowledge of the pathology of both dental and systemic disease. I am convinced that there is an urgent need to disseminate the knowledge of pathology through the medium of the monthly scientific meetings of the various local groups of practitioners, besides the education of the dental student.

I agree that every variety of systemic ailment or symptom has at one time or another been attributed to an infective focus, and it is this tangled mass of information that must be reviewed, reorganized, properly indexed and prepared for assimilation on a rational educational basis. I have heard one of our leading investigators of this subject discuss in a single lecture the following disease processes and attribute them to dental foci of infection: alopecia, torticollis, clonic and tonic muscle spasm, flaccid and rigid paralysis, vertigo, headache, iritis, neuritis, gastric ulcer, enteritis, polyarthritis, pericarditis, myocarditis, endocarditis and pyemia and, I am sure, some I have forgotten. I do not question that what he said may have been true, but I have since wondered whether he realized the great confusion that he must have brought to the minds of the men who listened to him. I am convinced that the task that confronts the dental pathologist is this: to rearrange his work in such fashion that the subjects are properly captioned and presented as covering types of disease processes. This must be done before we can hope to raise the present level of knowledge of pathology in the dental profession.

Several months ago, I heard one of our recognized pathologists cite the views of several of the leading oral pathologists and surgeons on the subject of infection and focal infection. No two of these opinions were in agreement. Imagine the confusion that must exist regarding these and other subjects among the practitioners who claim only an ordinary training.

During the past two decades, much has been said concerning the onset of systemic disease from foci of infection about the roots of teeth. In considering systemic results of dental infection, the first lesion to study is, of course, the inflammatory area found so frequently about the roots of teeth. The periradicular lesion may vary from a simple reactive arterial engorgement of the vessels of the peridontium to an acute suppurative osteomyelitis.

The local lesion may be chronic. When the infectious agent is well confined to the pulp itself and the peridental membrane is absorbing the toxic products of bacterial life, the inflammatory response will be mild. The chief evidence of injury will be manifested by degenerative changes in the cells and fibers of the periodontium. If the bacterial invasion of the pericemental structures is gradual, there

may be attending the degenerative cellular change mild lymphocytic infiltration of the tissue. In these instances in which the injury is meager, there is further evidence of the type of trauma in the accompanying fibroblastic reaction and the absence of cell destruction.

The local lesion may be subacute and will then be characterized by the formation of a spherical area about the infected region that is referred to as the root-end granuloma. The bony substance has been destroyed and absorbed. The spherical cavity within the alveolus is bounded by a margin of altered bone tissue that exhibits evidence of decalcification, and the remaining connective tissue framework forms the outer limit of the lesion. Immediately within this zone, there is almost invariably found a wall composed of densely packed concentric connective tissue fiber bundles that surrounds the central or infected region. This central area is comprised of a moderately vascular basic fibroblastic framework that is densely infiltrated with a variety of inflammatory cells. The preponderance of any particular type of cell is dependent on the severity and the nature of the intoxicating agent. In the acutely injured area, or if the infectious agent is pyogenic, the limiting wall is wanting and the fibroblastic granulations are not found. The bony barrier has been penetrated and the marrow elements have been invaded. There is an intense neutrophilic infiltration of the marrow spaces and rapid dissolution of the marrow elements.

In the next step, we enter the field that has led teacher, investigator and student into difficulty. What type of systemic lesion may an infectious dental focus produce? I agree that there are numerous possibilities to be considered and especially on a theoretical basis; but, from my meager experience, I contend that among dentists generally there is no definite understanding of the mode of operation, the mechanism of infection, the histopathologic process at the root end nor the type of systemic lesion possible. Therefore, a division of the types of generalized disease that may be produced should be classified and considered separately as far as we are able to do so. There is often extension of the inflammatory process to contiguous parts, the eye, the soft tissues of the mouth and face, the salivary glands and the sinuses, but the association of these with a primary dental lesion should be comparatively easy in the hands of a moderately skilful oral diagnostician. It is the generalized systemic diseases that have been readily associated with dental infection that should be questioned. In the light of our present knowledge we can place only a few definitely within the category. Of all of the types of heart disease that are known, only one can justly be brought into the realm of dentistry.

For this reason, subacute bacterial endocarditis has been chosen for my subject, and because (1) it is generally conceded by bacteriologists and pathologists to arise from infectious foci in the body; (2) the disease is thus far invariably malignant and we are without a single weapon with which to combat it; (3) streptococci of the nonhemolytic type are the organisms most frequently recovered from infected teeth; (4) one of the most common systemic diseases produced by the nonhemolytic strains of streptococci is subacute bacterial endocarditis with the associated complications; (5) the inflammatory response to intoxication by the nonhemolytic streptococcus is a nonsuppurative lesion somewhat similar to the radicular granuloma so widely known in dentistry, and (6) with the present methods of root canal therapy used by the general practitioner in the surroundings of the aver-

age dental office, we are countenancing the possible spread of the disease.

The clinical symptoms most usually associated with the disease are endocarditis, multiple embolism, splenic tumor, persistent fever, hematuria and bacteremia. The onset of the disease is insidious in both the infection of the primary focus and the secondary infection of the heart valves. The condition may be revealed during routine examination in altered heart sounds and an early valvular lesion. The patient is often in a state of cardiac failure. The heart is then found to be extremely enlarged. Precordial pain, pulmonary congestion and the production of rusty sputum may be attending signs. Dyspnea is a prominent feature, and if aortic incompetence is present, the typical Corrigan or triphammer pulse is always present. Multiple embolism may be manifested as the presence of petechiae in the skin, by sudden sharp pains in the region of the spleen and kidneys, by vascular occlusion with hemorrhage and, sometimes, sudden blindness in one eye, if the emboli lodge in the retinal vessels. Embolism in the brain may be discovered by disturbed cerebral function or hemiplegia. Blood culture is one of the most important diagnostic methods. Single negative blood cultures are meaningless, for there may be protracted bacteria-free periods. Cultures should not be reported negative until the material has been incubated at least a week.

The tonsils, teeth, throat, appendix and gallbladder are held to be possible points of primary infection. From these locations, the organisms enter the blood stream.

Prognosis is always grave and in most instances hopeless. Cases of healed lesions have been reported at necropsy, but certainly recovery from cases with clinical manifestations is very rare. There is no known treatment. The administration of antiseptics intravenously and transfusions have been tried without effect on the course of the disease.

More than 95 per cent of the cases have been found to be due to the presence of the nonhemolytic strains of streptococci of the viridans type. The organism is of low virulence both for man and for animals. The degree of tissue injury is relatively mild, and the inflammatory response even in the large organ infarcts is subacute in nature. There is evidently only a meager defensive mechanism at play, for the immunologic response is almost negligible.

The cardiac lesions are almost exclusively valvular. The first part affected is the edge of the leaflets near the insertion of the heart valves. The one most often and most consistently injured is the mitral; next, the aortics. The valves of the right side of the heart are seldom involved. Many authors contend that there is usually evidence of previous endocarditic lesions or congenital anomalies that predispose the regions to infection. The typical lesions are in the form of large polypoid, warty excrescences that project from the surface of the valve into the cardiac chamber. The lesions progress to the edge of the valve, which, on closing, becomes coapted on the opposing edge of the valve. The massive bacterial colonies usually spread to the adjoining mural endocardium or are implanted on it by the constant contact with the flapping valve leaflet. The entire valve may eventually be covered and the organisms may also spread along the cordae tendinae and the papillary muscles. The lesions are productive, although portions of the valve leaflets and cusps are occasionally destroyed.

Microscopic examination reveals large masses of bacteria attached to the surface

of the valve by a fibrinous network. The bacterial colonies may be imbedded in the fibrin net. The endocardium is soon destroyed, and the surface may be flooded with plasmatic exudate and new fibrin formed that serves as an additional source of attachment for the bacterial masses. The inflammatory response is seen to consist of lymphocytic infiltration and chronic fibrous or productive valvulitis. The deeper regions of the vegetations are the areas usually infiltrated with the lymphocytic cells. The underlying valvular connective tissue becomes partially hyalinized and cicatrized. The myocardium, if mural colonies are present beneath the vegetations, is infiltrated with lymphocytes and the subendocardial muscle cells may be necrotized or degenerated. About these small areas of altered muscle cells, there may be localized collections of neutrophiles. If rheumatic heart disease has preceded the bacterial endocarditis, Aschoff's bodies may be found in the myocardium.

The friable colonies of bacteria, continually whipped to and fro in the swishing current of the transmitted blood, sooner or later become detached and are sent out into the arterial stream to lodge in some fine calibered capillary, most often in the organs disposed to the formation of infarcts. These infarcts are usually anemic in type, but the embolic material is infectious; hence, new areas of infection are produced, but these areas are peculiarly nonsuppurative in character. The infarcted area soon undergoes cellular degeneration, death and cell dissolution. The destroyed area is eventually replaced by fibrous tissue. Infarcts of the skin are seen as petechiae, hemorrhagic areas and Osler's nodes. Large infarcts are produced in the spleen and the kidneys. There is a particular type of embolic lesion formed in the glomerular tuft. This is seen as a focal embolic glomerular nephritis. Only a few of the glomeruli become clogged and then only a portion of each glomerular tuft. These renal lesions heal readily, and the partially obliterated glomerulus gives the specific picture of endocarditic focal glomerulonephritis. A generalized glomerulonephritis may develop with uremic intoxication. Retinal embolism is common and may be petechial, or the retinal artery may become occluded; in which instance, sudden blindness occurs. Both types are associated with retinal hemorrhage. Infarcts in the small calibered vessels of the cerebrum are not unusual, and, occasionally, massive infarction of the large cerebral vessels may take place, and hemiplegia is of course produced.

The generalized lesions are not important. They are either due to systemic intoxication with widespread albuminous degeneration of the large glandular organs or they follow from decompensation of the heart, which has by this time been rendered incapable of continuing its work.

The self-sustaining days of the individual have long been past and life is on the ebb. Unless the patient dies of cardiac failure or intercurrent infection, a last embolus will lodge in one of the cerebral vessels, throwing the patient into a paralytic collapse, death ensuing.

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CHANGES ON THE ENAMEL SURFACE, A POSSIBLE DEFENSE AGAINST DENTAL CARIES*

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As there is no doubt that the surface of the tooth is the starting point of dental decay, it is rather remarkable that there is no unanimity of opinion as to the exact histologic structure of the enamel surface. It seems that all descriptions of enamel structure deal with the deeper portions without distinction between the outside and the center of the fully formed enamel.

Pickerill[1] states: "It is at the enamel surface alone that the process of caries is able to be prevented or checked," and he undertakes the first thorough examination of the enamel surface. In this description, the presence of imbrication lines is pointed out for the first time and the general conclusion is reached that there are considerable variations between the surfaces of different teeth, those which are less completely calcified being more liable to destruction. Plotz[2] observes a similar surface structure of the enamel, but concludes that it is of no significance in the onset of caries. Nishimura,[3] Williams,[4] Bödecker,[5] Fish[6] and Cape and Kitchen[7] observe a continuity between the organic sheaths of the enamel rods and the enamel cuticle.

It has been repeatedly shown that a membrane-like structure is present on the surface of all enamel, and this can be demonstrated very easily by subjecting the crowns of teeth to the action of acids. Concerning the nature of this structure and its possible significance, there is not total agreement. Chase[8] gives a thorough review of the theories concerning the nature of this film, and these, as a whole, point toward its being a remnant of the enamel-forming tissues. As the result of his own work, this author adopts the point of view that the membranous structure separated from the enamel by the action of acid has a connection with the

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†Rockefeller Fellow in Dentistry.

1. Pickerill, H. P.: Prevention of Dental Caries and Oral Sepsis, New York: Paul B. Hoeber, Inc., 1924, p. 63.

2. Plotz, R.: Ztschr. f. Stomatol., 29:1201-1277, 1931; per Deutsche Monat. f. Zahnheilk., 1:507, 1932.

3. Nishimura, T.: Schweiz. Monat. f. Zahnheilk., 36:1, 1926.

4. Williams, J. L.: J. D. Res., 5:27 (Sept.) 1923.

5. Bödecker, C. F.: D. Cosmos, 69:123 (Feb.) 1927.

6. Fish, E. W.: D. Rec., 48:289, 1928.

7. Cape, A. T., and Kitchin, P. C.: Histologic Phenomena of Tooth Tissues as Observed Under Polarized Light; with Note on Roentgen-Ray Spectra of Enamel and Dentin, J.A.D.A., 17:193 (Feb.) 1930.

8. Chase, S. W.: Anat. Rec., 33:357, 1926.

enamel-forming organ only in freshly erupted teeth and that in older teeth it is composed entirely of many types of bacteria. The most nearly constant finding is the presence of thread-forming organisms in parallel arrangement at right angles to the enamel surface, while, between them and the surface, a line of coccal forms is frequently seen. Chase is able to produce this film in protein-free mediums and thus cannot agree with Kirk,[9] who stresses the importance of salivary mucin in its formation. Gottlieb[10] shows that a keratinous structure is present on the surface of the teeth. He notes that there is an immunity to caries in the cases in which this and the ends of the enamel lamellae are completely hornified. In other cases, if the hornification is imperfect or absent, these organic structures serve as a nidus for bacterial growth. It is concluded that the degree of immunity to caries depends on the extent of this change in the enamel cuticle and the enamel lamellae and that prophylactic measures should be directed toward preserving these structures.

On account of this imperfect state of our knowledge, it seems necessary to discuss the nature of the structures at the enamel surface.

OBSERVATIONS

The presence of a film separable from the surface of all teeth was observed by immersing the teeth in various organic and inorganic acids. By recording the quality of this film and the surfaces from which it could be separated, an attempt was made to correlate the presence of this structure with the presence or absence of caries. This was found impracticable and was abandoned after the study of fifty teeth.

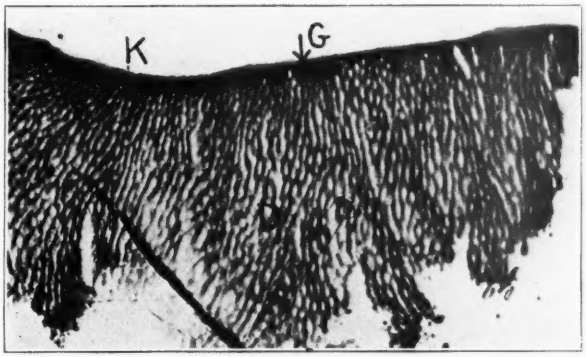


Fig. 1.—Decalcified enamel. *D*, organic matrix of enamel; *G*, increasing density or consolidation of rod sheaths toward surface; *K*, keratin-like cuticular structure. (×200.)

An attempt was made to study the membranous material removed from the teeth by staining it in bulk. For this purpose, stains were made with hematoxylin and eosin, silver nitrate, Gram stain, carbol fuchsin, Bismarck brown, methyl orange and safranin. It was indicated that a film could be removed from erupted and unerupted teeth, from

9. Kirk, E. C.: D. Cosmos, 52:729 (July) 1910.

10. Gottlieb, B.: Ztschr. f. Stomatol., 19:129, 1921.

scrubbed teeth and from film-free teeth immersed in human saliva for a few hours. It seemed that in some cases all types of bacteria were present, as well as certain material which gave a staining reaction suggestive of mucin. In other instances, the film was less dense and occasionally it showed indefinite structures resembling cell nuclei. On yet other occasions, especially in the scrubbed teeth, the separation of a fine structureless membrane occurred.

In order to decide on the conformation of the organic part of the enamel at and near the surface, an examination of

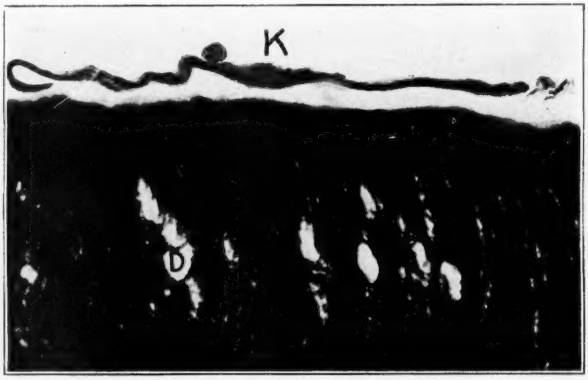


Fig. 2.—Decalcified enamel. *D*, organic matrix of enamel showing great increase in organic content (spaces are artefacts); *K*, cuticle in which cell nuclei are still visible. (×200.)

enamel sections was undertaken. First of all, ground sections were prepared from teeth freshly extracted in the clinic without much regard to type or age. These were ground in balsam to a sufficient thinness to permit a microscopic examination. Some sections were ground to a feather edge at one part of the enamel, the thickness increasing to more than that of the usual section at the other end of the enamel surface. Other sections were ground to a uniform fineness. These preparations were stained variously with basic fuchsin, eosin and silver nitrate. With the last, a variety of methods were used, but the most satisfactory results were obtained by precipitating the silver nitrate heavily and then washing with 5 per cent nitric acid, which effected a partial decalcification. Examination of these sections both by transmitted and by oblique light failed to give much definite knowledge as to the conformity of the rod sheaths as they approach the outside of the tooth. This failure was largely due to the fact that there was always a diffraction effect at the surface of the enamel which produced a haze, preventing fine resolution of detail. Better results were obtained with oblique illumination whereby a fine beam of light was thrown from above or below onto the enamel edge which was in focus under the lens of the microscope. By changes in the direction and amount of the light, it was possible to show the interrod material as dark bands or as brightly illuminated bands in a dark field. This was more marked when monochromatic light was used. It was possible in all sections thus examined to

show even bands of organic material of regular thickness passing toward the surface of the enamel, where it appeared to be cut off sharply at the level of the ends of the rods. In some cases, a slight widening or splaying out of the interrod substance was visible at the surface, but this was neither marked nor definite. The ends of the rods seemed to be quite free from any external transverse organic connection between the interrod structures. On account of difficulties in microscopy and uncertainty as to the previous condition of the enamel surface, these findings cannot be regarded as conclusive proof of the absence of an organic surface film.

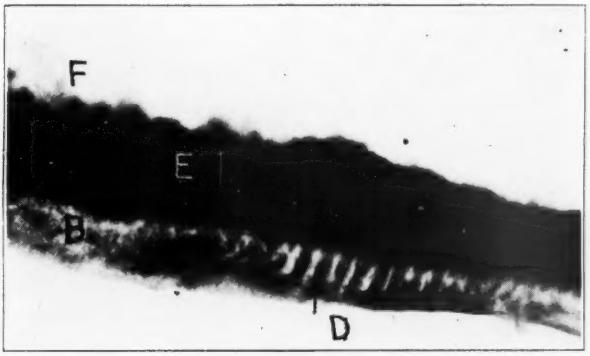


Fig 3.—Film separated from enamel surface. *F*, layer of gram-negative organisms; *E*, layer of gram-positive organisms; *B*, brown basement layer showing rod structure at *D*. (×460.)

To the same end, an examination of decalcified tooth sections was undertaken. Sections prepared for various purposes frequently showed remnants of decalcified enamel. In sections of unerupted teeth, which frequently decalcify to show a regular enamel matrix, it has not been possible to find a definite surface structure. Similarly, in rats' and dogs' teeth, although it was frequently possible to observe enamel rod sheaths, there were only a few instances in which any relationship with the surface could be seen. Sections of human enamel were prepared by the celloidin decalcifying method, but such are the uncertainties of this procedure that only a few of these sections showed an entire enamel surface. It is possible, too, that these sections showed this increased organic resistance on account of a degree of calcification less than normal; that is, on account of a slight degree of hypoplasia. In such sections, it has been possible to show enamel rod sheaths in relation to homogeneous keratin-like surface films (Fig. 1), to bacterial films and to films which exhibit an epithelial structure (Fig. 2). In most instances, a definite opacity of the enamel rod spaces, such as that seen by Nishimura,[3] was observed at the surface, the most superficial portion sometimes appearing almost solid. It would seem that the lengthy process of decalcification necessary in preparation of these sections interferes with the staining properties of the surface film, and in such preparations it was generally impossible to make out any details of the

structure. On this account and on account of frequent failures in the preparation of these sections, this method of study proved to be rather profitless and was used only until a simpler procedure presented itself.

It was found that very satisfactory observations could be made by examining sections of the surface film which had been prepared by the usual histologic sectioning methods. The method which was found to give the best results was to fix freshly extracted teeth in Zenker's solution and, after washing them thoroughly, to immerse them in 5 or 10 per cent nitric acid until the surface films separated. These films were then washed in several changes of distilled water and alcohol and embedded in celloidin or paraffin. The latter embedding material proved to be more satisfactory, especially as it permitted the use of gum tragacanth, which greatly facilitated the manipulation of the fine fragments of film.

In later preparations, it was found advantageous to divide the crowns of the teeth from the roots before separating the films in acid. In this manner, the presence of any peridental tissue or epithelium from the gingivae was avoided, and any tissues obtained must have originated from the enamel surface.

The most interesting observation made in the examination of sections prepared from material obtained in this manner was the fact that, very frequently, portions of the organic matrix of the enamel were included in the sections. This made the orientation of the films positive, and it was soon found possible to distinguish between the deep and the superficial portions of the film, even in the absence of any enamel structure.

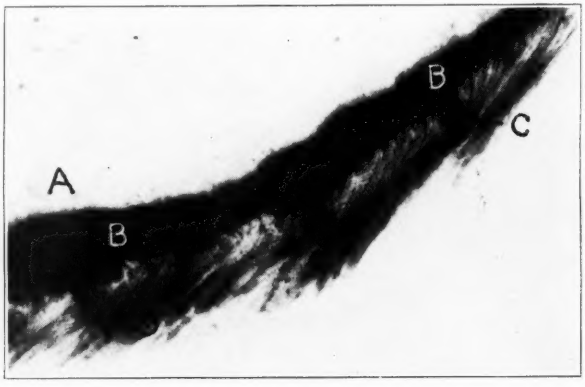


Fig. 4.—Film separated from enamel surface. *A*, bacterial remains; *B*, brown basement layer showing continuity with *C*, groups of consolidated enamel rod sheaths and, *D*, normal rod sheaths. (×460.)

Stains designed to differentiate the component parts of this film were employed to show the nature of any tissue found, the presence and the kind of bacteria and the presence or absence of mucin.

1. *Cuticular Structure.* — While no definite tissue was seen which showed either the epithelial or the cuticular structures attributed to Nasmyth's mem-

brane, there was sometimes a definite thin basement membrane separating the bacteria from the enamel matrix. This membranous structure appeared to be keratinous and, on such occasions, gave the typical staining reactions of this material. This was a somewhat uncommon finding.

2. *Surface Layer.* — More frequently, a brown colored layer was observed beneath the bacterial part of the film. This appeared either as a fine even layer beneath the bacterial mass on the surface of the enamel, or as an accumulation of considerable thickness which obscured the relationships of the other component parts of the film. Sometimes, this brown substance seemed to be a structureless irregular layer; at other times, it showed continuity with the enamel matrix or was composed in part of a structure very similar to it. This enamel-like structure could generally be made out only by the use of filtered light and appeared either as the honeycomb or palisade pattern corresponding to the cross-section or longitudinal section of the enamel rods (Figs. 3-6). Occasionally, isolated groups of rods in both decalcified and ground sections have shown along varying portions of their length an appearance of consolidation resembling a penetration of the brown stained material, while adjacent rods presented the normal open structure (Figs. 3, 4, 6 and 7). This solidification bore a striking resemblance to the change which has been noted in other investigations[11] in the substance of the enamel, when the carious process was either arrested or progressing very slowly. It seems

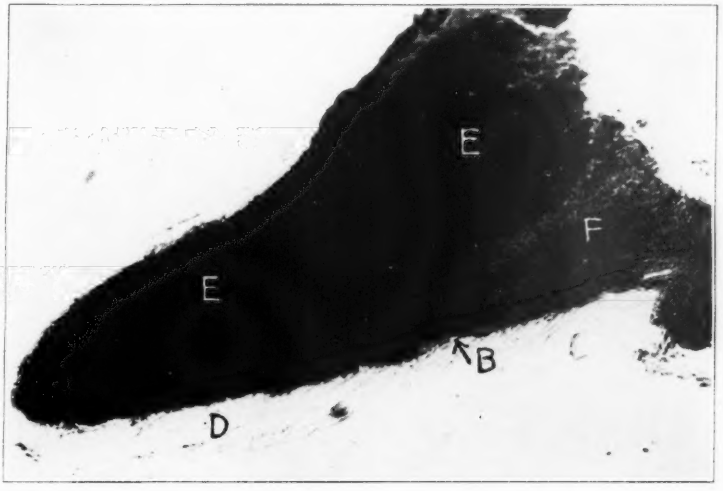


Fig. 5.—Film separated from enamel fissure. *E*, areas of gram-positive bacteria; *F*, areas of gram-negative bacteria, predominantly cocci; *B*, fine brown basement layer continuous with *D*, lightly stained enamel rod sheaths. (×230.)

11. Bibby, B. G.: J. D. Res., 12:99 (Feb.) 1932. Friesell, H. E., and Enright, J. J.: D. Cosmos, 74:720 (July) 1932.

probable, therefore, that this acid-resistant material has had its origin from either the enamel cuticle or the organic substance of the enamel rod sheaths which, under the influence of the action of saliva and bacteria, has taken this characteristic form. It may be possible to interpret this change as a passive defensive action of the organic structure of the enamel occurring at its surface in conjunction with a similar change in the culticular remnant. Such a process on the surface of the enamel could account for the yellowing or darkening which takes place in the teeth of the aged. It is also possible that the connection between extremely white teeth and a susceptibility to caries may be dependent on the absence of such a change.

These observations are compatible with Nishimura's[3] description and illustrations of a terminal condensation in the enamel rods, Hopewell-Smith's[12] mention of a pigmentation of the surface membrane and Beretta's[13] thickening of the enamel cuticle, all of which are probably similar changes. Gottlieb[10] noted a brown superficial layer on the enamel and attributed it to the effect of organisms acting on incompletely hornified enamel cuticle. He considered this an indication of a destructive process. When we recall the fact that most of the teeth examined in these studies had remained immune from caries for thirty or more years, it seems impossible to accept this condition of brown pigmen-

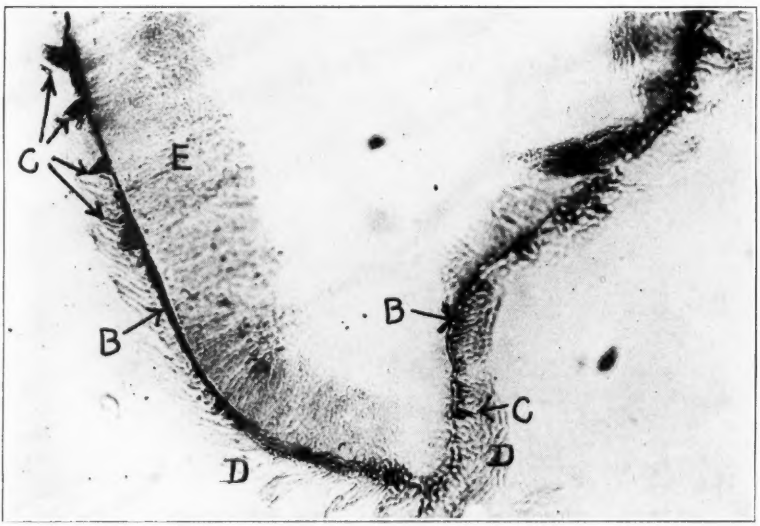


Fig. 6.—Film separated from enamel surface. *E*, lightly stained organisms, some showing thread form; *B*, brown basement layer showing continuity with *C*, groups of consolidated enamel rod sheaths; *D*, normal enamel rod sheaths. (×210.)

12. Hopewell-Smith, Arthur: Dental Microscopy, Philadelphia: S. S. White Dental Manufacturing Co., 1899, p. 163.

13. Beretta, A.: D. Cosmos, 57:584 (May) 1915.

tation as evidence of susceptibility to decay. On the contrary it would seem to be associated with a high degree of resistance against caries. It may be that this formation is the result of bacterial action on the enamel cuticle, as suggested by Gottlieb, though, on account of the great thickness of this layer in certain instances, it would seem probable that it must have some additional source. It may indicate a thickening by external deposits, but its structure suggests an origin in some change at the surface or within the substance of the enamel itself.

surface film, sections were stained by the Gram stain and counterstained with safranin, fuchsin or eosin.

In the examination of sections prepared from almost 100 teeth, it was possible to make out the bacterial layer upon the remains of what could be recognized as the enamel surface. The most interesting observation was the almost unfailing presence in the deep side of the film of a layer of gram-positive thread-forming bacteria arranged like a picket fence with the elements at right angles to the surface (Figs. 8-9). This layer was of a varying thickness, depend-

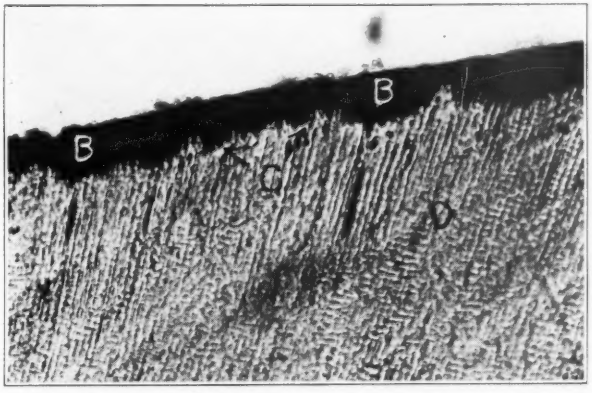


Fig. 7.—Ground section of enamel surface. *B*, brown layer showing continuity with *C*, pigmented enamel rods which probably remain consolidated on decalcification; *D*, normal enamel. (×210.)

It is suggested, therefore, that, under certain conditions, the enamel surface or the organic structures which are related to it are changed into a pigmented mass which sometimes retains the morphologic appearance of enamel. This pigmented material is resistant to the action of acids and may conceivably form a barrier which prevents further decalcification of the teeth.

3. *Bacteria.*—For the purpose of studying the bacterial components of the

ing on that of the whole organismal mass. It varied from 3 or 4 to as much as from 50 to 60 microns in depth, but, in most instances, there was a superficial margin of ten or more microns in width which had lost the Gram stain (Figs. 5 and 10). These thread forms were sometimes curved and sometimes showed a tendency to interwine, but these appearances were not striking. In the parts where the thread arrangement was characteristic, branching was not observed,

but a tendency to granularity or to the presence of irregular coccal bodies within the thread itself could frequently be noticed. By the use of different special illuminations, it was generally possible to trace the course of these gram-positive threads into the gram-negative superficial portion of the film, in which part, although they remained organically continuous, they had lost their property of retaining gentian violet. This variability in staining reaction, the granular structure and the absence of branching are typical of certain strains of *Leptotrichia* and *Fusiformis* described by other investigators as *Leptothrix*. It is well to point out here that the forms observed in these section preparations were of

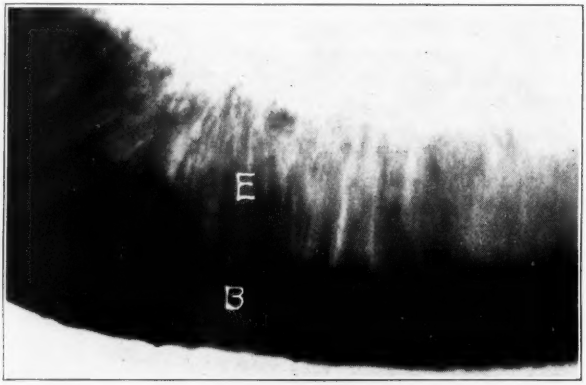


Fig. 8—Film separated from enamel surface. *B*, brown basement layer; *E*, gram-positive bacterial threads arranged at right angles to surface. (×1,000.)

Fig. 9.—Higher magnification of gram-positive bacterial threads. A granular structure at *G* is just discernible. (×1,000.)

finer diameter than any of the strains of *Leptotrichia* which we have observed in culture or even in smear preparations from the mouth. It is thought that this can be explained as an effect of the acid treatment and embedding process, for it was noted that all bacterial forms such as cocci and bacilli seemed of less than usual size. The tendency to lose the stain in the superficial portion is apparently an inherent property of the organisms rather than the result of insufficient penetration of the decolorizing reagent into the deep part of the film. This conclusion was suggested since certain parts of the film remained gram-positive in their deep portions, although in that immediate locality there were no subjacent structures. In connection with this staining phenomenon, it is interesting to note that in cultures of *Leptotrichia,* one end of a thread is sometimes gram-negative, while the other end of the same thread gives a positive reaction. In cultures, it is the older organisms which lose their gram-staining properties and, on this account, one would expect the deeper portions rather than the superficial to lose their stain. As a change of environment may change the Gram reaction,[14] it is possible that a difference of growth conditions between the superficial and the deep portions of the film may be responsible for the different staining reactions. Cultural experiments have failed to show this effect in growths of *Leptotrichia* in mediums of different carbohydrate contents and acidities or under various oxygen tensions.

On no occasion was it possible to find beneath this thread layer a coccal structure such as that which was described by Chase.[8]

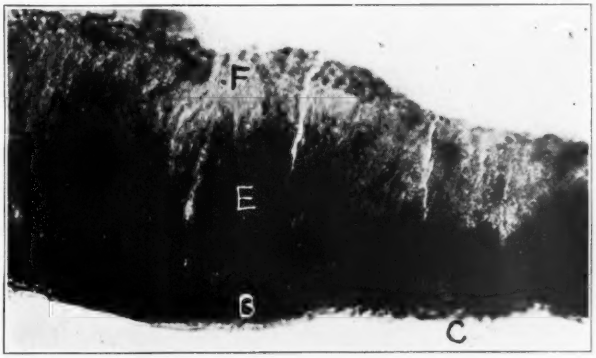


Fig. 10.—Film separated from enamel surface. *B,* brown basement layer; *C,* pigmented enamel rod sheaths; *E,* deep layer of gram-positive bacterial thread forms; *F,* gram-negative bacterial forms. (×700.)

In several instances, "heads" of *Leptothrix racemosa* were observed. The elements of this peculiar organism were generally found in a few areas of the film, but were not apparent in the remaining portions. It was easier to see these "heads" where they projected beyond the surface, but they could sometimes be found in the organismal mass (Fig. 11). The presence of this organ-

14. Stern, E. W., and Stern, A. E.: J. Bacteriol., 10:13, 1925.

ism was by no means a common finding, and both the organism itself and its fragmented elements were present less frequently than the examinations of smear preparations from tooth surfaces would lead one to expect. Both gram-positive and gram-negative coccal and bacillary forms were constantly present. It was difficult to obtain a definite interpretation of the morphologic structures of the negative forms. Coccal types were prominent, while large and small bacillary forms were considerably less common. These cocci generally appeared in an aggregate, sometimes forming masses of as great a diameter as 50 microns. These were frequently demarked sharply from the surrounding gram-positive areas. This aggregate is apparently made up of organisms which have grown so readily that they have excluded other types, giving rise to small colonies. Similar colony formations by gram-positive cocci were seen a number of times. A radiating arrangement of somewhat clubbed gram-positive threads was observed twice. In the portions of the film not occupied by *Leptotrichia* or the above-mentioned colonies, the bacterial picture was somewhat obscure, consisting of mixed coccal, bacillary and thread forms of varied types. A more accurate analysis of the organismal content of these sections was precluded by the density of the bacterial masses or by the presence of material of an unknown nature. The most striking observations were, therefore, the constant presence of gram-positive threads in the deep portion of the film and the frequent occurrence of gram-negative coccal forms.

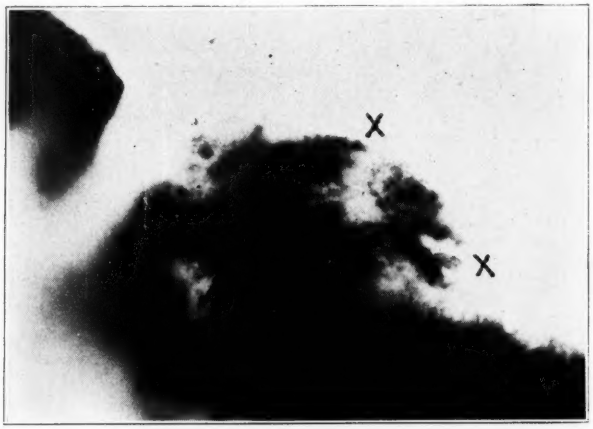


Fig. 11.—Portion of bacterial film from enamel surface. A cluster of Leptothrix racemosa with "heads" visible at *X*. (×1,000.)

4. *Mucin.* — To test for the presence of mucin, films freshly separated in acid solutions were washed and treated with methyl orange, methylene blue and safranin. These examinations were somewhat unsatisfactory on account of the thickness of the films; and because of the irregularities in the specimens, there was no certainty as to the type of tissue. Uniformly stained areas suggested the presence of mucin, but from what could be determined as to their nature they

may have represented fine cuticular structures.

Observations on paraffin and celloidin sections were also made. For this purpose, sections which showed undifferentiated and somewhat homogeneous areas by the Gram technic were chosen. These sections were treated with Bismarck brown or with Meyer's mucicarmine stain. In them, it was not possible to find areas which gave a definite mucin coloration with either of these reagents, although with the former, in a few instances, a slight homogeneous brown was discernible between the bacterial bodies, but at no time marked. In the deep thread layer of the film, no chromophilic material (mucin) was ever found between the bacterial elements. From these results, it would seem that mucin is present only in slight amounts in certain parts of films from the surface of teeth. This finding is in accordance with that of Chase,[8] who concludes that the films separated from the surface of the enamel are purely bacterial in nature. It is certain that the mucin of the saliva must be present on, if not in, these structures, since they are continually washed by it. Its absence in any appreciable amount as indicated by the color reactions may be accounted for by its dilution in the oral fluids, by its loss in the treatment of the teeth before or during the separation of the films or by its rapid destruction or utilization by the mouth bacteria.

CONCLUSIONS

Practically all teeth are covered by a membranous film which can be separated from them by immersion in acid solutions.

In the process of separation, the decalcified superficial part of the enamel is frequently removed simultaneously; which renders a study of the enamel surface possible.

On teeth which have been erupted for a number of years, the film seldom shows an epithelial or keratinous structure such as has been described as Nasmyth's membrane.

The organic structures of the enamel surface seem frequently to undergo a change which results in their pigmentation and in an apparent alteration in the density of the enamel rod sheath.

As the result of this change or of an accretion of some product of bacterial or salivary action, a thick somewhat structureless brown layer of unknown composition is formed on the outside of the tooth.

A bacterial mat is found upon this changed surface or upon the normal tooth. This shows a deep layer of gram-positive thread forms (probably *Leptotrichia)* and the presence of other bacterial types, the most prominent of which are gram-negative cocci.

The amount of mucin in these films is negligible.

As a result of the superficial changes described, the surface becomes resistant to the destructive action of acids and bacteria. This resistance probably protects the deeper portions of the enamel from decalcification and thus could act as a defense against dental caries.

The practice of calling all pigmentations of the enamel "incipient caries," appears to be unjustified, since many of the processes associated with pigmentation appear to be self-limiting and do not result in extensive destruction of the tooth.

EFFECT OF THE PERIODONTAL LESION IN ITS RELATION TO OCCLUSAL TRAUMA*

By E. D. ROSE, D.D.S., Memphis, Tenn.

UNTIL twenty years ago, there were but few periodontists in this entire country, and of those few, almost every man had some special treatment all his own, instruments of his own selection and a pet remedy that he used on his patients. The various methods of treatment were almost as numerous as the specialists, and were as widely separated as the different sections in which these men lived. Every little while, a member of the profession offered a "sure cure" for periodontoclasia, and sometimes this was used by the periodontists and recommended to their patients. But, in all cases, it was found, much to the regret of the periodontist and the dissatisfaction of the patient, that while some of these remedies destroyed pus (which is present in about 2 per cent of cases of periodontoclasia), instead of the disease being cured or even benefited, its progress was hastened.

Since the return of the troops after the close of the World War, with the consequent scattering of Vincent's infection over the United States, periodontal disease has increased at such a rapid rate that it has now taken rank as the most common of all human diseases. This being the case, it will require the united skill of the entire dental profession to handle the situation. But in spite of the fact that there has been no advancement made in dental science equal to that made in the diagnosis, treatment and prevention of periodontal diseases, the public has not benefited by this progress because the periodontists have failed to agree among themselves as to a method of procedure.

The man who is specializing in periodontia criticizes the general practitioner of dentistry for saying that he does not cure periodontoclasia; yet, in a vast majority of cases, the general practitioner is exactly right in his statement. Unless the periodontist can show that, in the cases he treats, there is an actual reattachment of the soft tissues to the root surfaces and a regeneration or solidification of bone (often both of these take place), the disease has not been cured: only some of the symptoms have been relieved. We have said that periodontal disease is increasing daily; and it will continue to increase until the dental profession as a whole agrees that Vincent's infection cannot be cured with medicine alone, and is not cured until, after the elimination of the acute infection, the occlusion is balanced, a prophylactic treatment is given, all necrotic tissue and all calcareous deposits are removed and the soft tissues are made to reattach themselves to the root surfaces. For it is a lamentable fact that a large percentage (I do not believe that 90 per cent is too high a figure) of the

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

cases of Vincent's that have been treated by the medical and dental professions with medicine emerge from one stage of periodontoclasia only to enter another.

A proper diet is an important factor in the prevention of periodontal diseases; for without food rich in calcium and phosphorus, the bony structures of the mouth will suffer, and without coarse food which requires a great deal of mastication, the gingivae and other soft tissues of the mouth will become flabby and lose their resistance to such an extent they they will fall an easy prey to bacteria. Because it is impossible to isolate the teeth from the rest of the body and treat them as separate entities, we must bear in mind that the individual must be at all times on a balanced diet, in order to keep the masticatory apparatus in good condition, that the general resistance may not become lowered. Scientists are virtually agreed that caries is a dietary deficiency disease, and many authorities assert that dental periclasia is a mechanicochemical dietary deficiency disease. These things being true, it behooves us as members of the dental profession, if we would keep abreast of the times and fulfil our obligation to our patients, to make a special study of food, nutrition, assimilation and elimination. Our patients look to us for guidance along these lines. In times past, we have referred them to the family physician for advice as to diet. This is not fair to us, to the patient or to the physician. It is true that we need and desire closer cooperation between the medical profession and our own, but it must not be forgotten that whereas a very small percentage, comparatively, of the physician's patients suffer from dietary deficiencies, a very large percentage of those who come to us need expert counsel. Therefore, simple justice to our patients and to ourselves demands that we qualify to meet the need.

Sanitation, too, is an important factor in the prevention of periodontal diseases, but in using this term I have in mind not only the sanitation of the oral cavity, but also that of the entire body. Not only must the tissues of the mouth be kept clean, but also no putrefactive matter or waste material must be allowed to remain within the alimentary canal. For this reason, a sufficient amount of bulk must be included in the diet to insure that the process of elimination be carried on properly. Practically every successful periodontist has determined on some satisfactory method of massaging the gingivae and brushing the teeth and he never discharges a patient until he is sure that this method has been acquired. Since periodontoclasia has become so prevalent, the time has come for the general practitioner to learn for himself some accepted, standardized method of caring for the teeth and stimulating the periodontium and then teach it to his patients.

But proper food and sanitation, necessary though they are, are not sufficient. The health of the body rests upon a foundation of food, sanitation and function. No matter how nearly perfect the diet nor how cleanly the individual, unless the various organs function properly, he will be in a state of continual ill health. So, too, dental health rests upon a triple foundation of food, sanitation and function. Though one adheres with greatest strictness to a perfectly balanced diet, and is so meticulous concerning oral sanitation that he becomes obnoxious, if his dental organs fail to function properly, there will result a state of ill health which will affect not only the teeth themselves, but also the entire body.

The human body was designed with

the idea that every organ and tissue therein should have some definite work to do, and that no organ (with the exception of the temporary teeth) and no tissue should reach the end of its usefulness ahead of the remainder, but that all should endure throughout life. With these facts in mind, let us remember that the function of the gingivae is to seal the dento-alveolar joint, and that the alveolar process is not transitory in character, but should last as long as the remainder of the body. When the masticatory apparatus is functioning properly, the dento-alveolar joint is tightly sealed, the alveolar process is intact, the structure of each tooth, whether natural or restored, is perfect, the points of contact are normal and each tooth stands vertically in its socket in correct approximal relation to its fellows and in proper occlusion with its antagonists.

The teeth are the only mechanical organs of the human body. They do not repair or rebuild themselves or regenerate as do the bones and the soft tissues; neither do they adapt themselves readily to changes in their relation to each other. From personal experience with a car, watch or clock, each one of us is more or less acquainted with the working of gears. There are many points of similarity between the gears in a car, watch or clock and the masticatory apparatus.

The gear wheel of mechanics is "a toothed wheel used to transmit motion and power from one part of a machine to another." The masticatory apparatus is a toothed process used to transmit potential motion and power in the form of food to the human body. In order that gear wheels may do their work, their teeth must "mesh" or fit together exactly as the designer intended. In order that the masticatory apparatus may function, the teeth must occlude perfectly; that is, they must stand in their normal vertical position, their points of contact must be normal, their cusps must not be abnormally long nor their fossae abnormally deep, and when they are brought together in any of the movements of the mandible, the pressure or force of the bite must be equally distributed over the entire dental arch, and the lateral and protrusive movements accomplished without the slightest suggestion of a trip. If a corner is broken from one of the teeth in a gear wheel or if one of the teeth is missing, i.e., broken entirely off, the usefulness of the entire wheel is destroyed. If, in the masticatory apparatus, a tooth is misshapen or is not built up properly when restorative work is done, or if a tooth is extracted and is not replaced immediately with a properly constructed tooth or the space is not retained by an orthodontic appliance, the occlusion is wrecked.

No masticatory apparatus can function if it has not been kept normal from infancy. Whenever one of the temporary molars is lost too soon and the space is not retained, the entire masticatory apparatus is on the road to maladjustment, malocclusion and ultimate destruction. Any dentist who is just out of college knows the evil effects of the loss of any one or more of the permanent teeth, and that such damage is greater when one of the first permanent molars is lost. Even the loss of an approximal surface on a temporary molar (owing to decay and the restoration of the tooth with a flat amalgam filling instead of one that builds out the contour of the tooth) will interfere with the occlusion of all of the teeth on that side and may, later in life, affect the occlusion of all of the teeth. When any one of the molars or bicuspids is in abnormal

alinement, every other tooth on that side back of the cuspids will be in a like condition and, during the movements of the mandible, it will be impossible for them to function properly because the force of the bite will not be uniform and will not be received by all of them at the same time and at the angle which was intended.

Normal teeth that are in proper vertical position and have neither abnormally deep fossae nor abnormally long cusps cannot be traumatized. But when the form of a single tooth is destroyed by restorative work, every tooth on that side is affected, and even those on the other side may become involved. The abnormal striking of teeth that are out of position, out of the line of occlusion both vertically and horizontally, can do nothing but destroy the entire periodontium.

If the supporting structure happens to be sufficiently strong to hold these traumatized teeth until they can wear down into occlusion, they will not be destroyed. Unfortunately, we rarely see an alveolar process strong enough to support maloccluded teeth until sufficient wear has taken place to render the occlusion something like normal. Besides, it is not when the individual is masticating hard, fibrous foods that the greatest damage is done, but when these abnormally striking teeth pass through soft food and come into contact. Again, every time one swallows, the teeth are brought into centric occlusion. This constant abnormal striking brings about a change in the pericementum and the alveolar process. Furthermore, when traumatization has once started, the teeth are never comfortable, and the individual, in his more or less conscious attempts to remedy matters, acquires various occlusal habits that are extremely harmful. This feeling of discomfort is always present and even causes a gritting of the teeth during sleep. These nocturnal excursions of the mandible are responsible for much of the damage done to the periodontium.

Thirty-five or forty years ago, the old timers in the dental profession divided pyorrhea into "pseudopyorrhea" and "true pyorrhea." Box has divided the same disease into what he terms periodontitis simplex, which is the same as the "pseudopyorrhea" of four decades ago, and periodontitis complex, which corresponds to the "true pyorrhea" of that period. Stillman and McCall use the term pericementoclasia to describe the type called periodontitis complex by Box and "true pyorrhea" by the old timers.

Periodontitis simplex, or pseudopyorrhea, is characterized by gingival inflammation, with much calculus, and with uniform shallow pockets, principally between the teeth. There is no change in the position of the teeth and no looseness. This type usually affects a considerable area. It is caused by an unsanitary condition of the mouth, the presence of calculus and errors in diet. It is easily diagnosed, and, unless the occlusion becomes unbalanced, its symptoms can be relieved by the proper instrumentation, the elimination of the pocket (as will be described in the discussion of periodontitis complex) and the institution of the proper oral hygiene and a balanced diet. If for any reason the occlusion becomes unbalanced, this type very quickly merges into periodontitis complex.

Periodontitis complex is always caused by traumatic occlusion. When this condition is once inaugurated, there soon develops in the pericementum Box's "new tissue," rarefying pericementitis fibrosa, which causes an elongation of the traumatized teeth. There is a conse-

quent breaking down of the pericemental fibers, and the teeth drift into abnormal positions. When the changes due to trauma are initiated in the alveolar process and the pericementum, it is not long until the resistance of the gingivae is so lowered that the invasion of bacteria is easily accomplished. The progress of the pocket then becomes more rapid. The serumnal calculus that is found deep down on the roots of the affected teeth is never a primary factor in the disease, but accumulates after it has been inaugurated. Of course, after the calculus is deposited, it becomes a wonderful holding medium for food and bacteria, produces a great deal of irritation of the gingiva and tends to hasten the progress of the disease. Development of the pockets, which are deep and narrow, is a late symptom of this type of periodontal disease. All of the instrumentation, medication or surgical work on the gingivae that it is possible to employ will do this type of periodontoclasia no good at all unless an occlusal equilibrium is established.

If the general practitioner would learn to recognize the early symptoms of periodontal lesions, and if his patients were so educated that they would look with suspicion on any tooth that evidences a slight soreness or changes its position to even the slightest degree, the formation of deep pockets could be prevented.

Periodontitis complex, pericementoclasia, or true pyorrhea, is not difficult to cure if there has not been too much bone and pericemental destruction and the disease has not penetrated the bifurcations too deeply. All that is necessary is to correct the occlusion, thoroughly plane and polish the roots surfaces to the very depth of the pocket (leaving no scratches whatsoever and no necrotic pericemental fibers), remove the epithelial lining from the periodontal wall of the pocket to its greatest depth, adapt the soft tissues to the root surface, secure a blood clot and seal it with an impervious varnish, and polish the crowns and necks of the teeth. Although this method of treatment is surgical and requires a type of operation of the most exacting and detailed character because the epithelium, the microscopic tissue which lines the periodontal wall to the very depth of the pocket, must be removed before any reattachment can be obtained, it is accomplished without the sacrifice or mutilation of any tissue. This being the case, the method does not violate that cardinal principle of surgery which provides that no tissue of known function shall be mutilated or sacrificed unless it is diseased beyond repair and the life and health of the patient are at stake. The gingiva has a most definite and important function, i. e., to seal and protect the dento-alveolar joint that the masticatory apparatus may be preserved and the health, appearance, and consequent happiness of the individual conserved. With the exception of malignancy and the presence of an epulis, there is no disease of the gingiva that cannot be overcome when a correct diagnosis is made and the proper treatment given. The gum lancet is an instrument that is not necessary in the treatment of periodontal diseases, not even in extreme hypertrophic gingivitis; nor should it ever be used in parietal abscess.

The first step in the correction of traumatic occlusion is to render centric occlusion normal. Establishment of normal centric occlusion in a mouth with few or no fillings is usually very easy, at times requiring no grinding at all except to lower an abnormal transverse ridge in the upper molars; but the estab-

lishment of normal centric occlusion in a mouth where there has been a great deal of restorative work done by different dentists, using amalgam, hard gold, soft gold and synthetic porcelain, is another matter altogether. In an endeavor to establish centric occlusion, there are four things that should be remembered: 1. All teeth carrying crowns, bridges or inlays that feel longer than the other teeth when the patient awakes in the morning are doomed to be lost unless the occlusion is corrected, and this type of malocclusion can be corrected only by grinding or by the reconstruction of restorative work. 2. Many dentists have a habit of telling the patient who complains of soreness in a tooth that has recently been restored with an inlay, crowned or attached to a bridge that this condition will pass in a few days. This is true of the soreness, but it will not be due to the fact that the tooth has been pressed into the socket or that the occlusion has been corrected by attrition, but that the bone has started to absorb, and therefore the pain ceases. Teeth of this kind, if bone absorption continues, finally become loose and must be removed. For that reason, patients who complain of pain after restorative work should never be dismissed until the occlusion is normal. Sending such a patient away with the statement that the pain will cease in a few days is simply signing the death warrant of that particular tooth. 3. When the mouth has been fully restored with poorly constructed dental work and centric occlusion is very much interfered with, it is sometimes possible to restore normal centric occlusion only by employing the normal unfilled teeth which remain in the mouth as a guide (provided there are enough of them), removing and reconstructing all restorative work and giving each tooth its natural anatomic contour. 4. In establishing centric occlusion, the relation of the nose to the chin must not be changed. If inlays or crowns on both sides of the mouth keep the normal teeth from coming into normal occlusion and there are enough normal teeth left to act as a guide, all of this restorative work can be removed and reconstructed, or one can grind it into occlusion without any fear of bringing the nose and chin too close together. But if, in establishing normal centric occlusion, one should indiscriminately grind the buccal surfaces of the lower teeth and the lingual surfaces of the upper teeth, the nose and chin will inevitably be brought too close together; a condition that will, in a majority of cases, sooner or later interfere with the hearing of the patient. Therefore, unless an individual tooth extends beyond the normal occlusal plane, neither the lingual surface of an upper tooth nor the buccal of a lower tooth should be ground.

There are cases in which, if any results whatsoever are obtained in the treatment of periodontal diseases, it will be necessary to reshape entirely some of the buccal cusps of the lower bicuspids and molars and the lingual cusps of the upper bicuspids and molars. This will have to be done more frequently in those cases (which we see so often) in which, in the upper molars, there is a great deal of gingival recession on the lingual surface and the periodontal disease extends almost to the root bifurcations. It is these upper molars with a receding gingiva on the lingual aspect that give the periodontist the most concern. Sometimes, it is necessary to reduce the width of these teeth buccolingually, doing most of the grinding on the lingual surface; and it is always best, in far advanced

cases that have not quite reached the bifurcations, to slightly disocclude the lingual cusp. One should never, under any circumstances, interfere with the occlusion of those cusps of the lower teeth which strike in the central fossae of the upper molars. In the upper molars which have a great deal of gingival recession on the lingual surface, there is often an abnormally prominent transverse ridge. This should always be ground so that every part of the tooth thus affected is brought into the line of occlusion.

After normal centric occlusion is established, the next step is to restore to their natural shape the six upper anterior teeth for reasons of esthetics. The grinding should then follow, nearly all of which can be done on the six lower anterior teeth. Occasionally, it is necessary to do a little grinding on the lingual surface of the six upper anterior teeth, in the case of an undue prominence on the lingual surface of the upper incisor. The six lower anterior teeth should be so shaped that in the protrusive movement of the mandible, as many teeth as possible will be brought into contact at the same time. If, in this movement, the operator can bring as many as six teeth into contact at once, he is doing exceedingly well; if four (the four incisors), he is still doing well; but it sometimes happens that the only contact one can get in this protrusive movement is that of the four lower incisors with the two upper central incisors. It must be remembered that the thing to be prevented is the tripping of one or more teeth during the various movements of the mandible.

The next step after the protrusive grinding is the lateral grinding; that is, the shaping of the inclined planes of the teeth so that the patient can move the mandible from side to side without tripping one or more teeth. This is usually accomplished by grinding on the buccal cusps of the upper bicuspids and molars. It is sometimes necessary to begin the lateral grinding on the lower incisors and cuspids. When the grinding has been done properly, the lower incisors and cuspids are rarely interfered with. It must not be forgotten that when, in the normal movements of the mandible, the bicuspids and molars are in contact during the process of mastication, the lower incisors and cuspids slightly miss the six upper anterior teeth.

The food pack is an important factor in the progress of periodontoclasia, and unless it is eliminated, the disease will never be cured. The early writers on periodontia recognized the food pack as one of the causes of periodontal disease, but at that time nothing was known about traumatic occlusion. It has been proved that the food packs which occur in the case of perfectly sound teeth in an individual who has never lost any of his teeth are caused by the wedging apart of the sound teeth as a result of traumatic occlusion. If the transseptal fibers have not been destroyed, it is amazing how many loose contacts will become perfectly tight when the occlusion has been rendered absolutely normal, provided there is left no sharp cusp which will come between two teeth and wedge them apart. And even when all of the transseptal fibers have been destroyed by traumatic occlusion and pocket formation, it is surprising how many of these teeth will return to normal contact with the approximating teeth when the occlusion has been made normal. For that reason, no sound teeth should be cut into and the point of contact restored until sufficient time has elapsed for the teeth to have a chance to drift into posi-

tion. Very often, when a case is first started, it seems that several restorations will be required in order to do away with food packs; whereas, if the closing of the contacts is postponed for a time, it will be found that very often it is possible to close the contacts between the cuspids and the third molars with only one inlay, and in some cases none at all will be needed. The periodontist who always refers cases to the general practitioner for the purpose of having food packs eliminated by the insertion of inlays sometimes does not see these patients for several months, but when they return to the office, the point of contact between the teeth where the food pack was located is weak or there is no contact at all. In conditions like this, the periodontist, either mentally or verbally, blames the general practitioner for not carrying out his instructions. A careful examination will show that the periodontist is the one who is at fault because he failed to balance the occlusion, and it was the condition of traumatic occlusion which separated the teeth the second time. Except in the case of a filling or an inlay with a flat approximal surface, wherever a food pack exists, traumatic occlusion should be suspected.

All traumatic occlusion cannot be relieved by grinding alone. It is sometimes necessary to combine orthodontic treatment with grinding. (When orthodontists realize that it is impossible to get perfect occlusion by means of orthodontic treatment only, without some reshaping of the unworn inclined planes, fewer teeth that have had orthodontic treatment will be lost because of periodontoclasia.) Teeth that are in supraclusion should always be brought into abnormal occlusion by grinding. Cases in which the mandible is just slightly forward, allowing too much pressure in the region of the six anterior teeth, can be improved by grinding and a slight reshaping of the bicuspids and molars so that they will not produce trauma when moved laterally and protrusively. When the teeth are not in proper vertical position, and the force upon them is in an oblique direction, grinding sometimes does more harm than good. Cases of this kind should be corrected by orthodontic treatment; but it is unfortunately true that many patients whose occlusion can be rendered normal only by this means come to the periodontist after it is too late in life for it to be given. He then has but one course open to him, and it does not always yield satisfactory results: he must reshape the inclined planes so as to give to the mandible the best movement possible.

To quote from an earlier paper of mine:

> Persons who have been on an unbalanced diet from prenatal life have, as a rule, lost their first molars, consequently their occlusion has been abnormal since childhood. The occlusion in such cases is usually so bad and the masticatory apparatus so mutilated that it is impossible to render the occlusion normal by grinding, and, usually, when these people reach us they are too old to have any orthodontic treatment undertaken. In cases of this kind a thorough diagnosis should be made from a study of articulated models, and if it is found that it is necessary to re-build the entire masticatory apparatus the patient should be apprised of this fact before any sort of treatment is begun, and advised that no permanent relief can be promised unless the masticatory apparatus can be built up so that the individual movements of the mandible will not be interfered with.
>
> Some of the most difficult knowledge for the dentist to obtain is a thorough understanding of occlusion. The deeper he goes into the matter the more clearly will he see that a large majority of the cases that he has failed to balance by grinding can be corrected only by re-building the entire masticatory apparatus. Most of the badly mutilated mouths in which several teeth have been lost and restor-

ative work has been attempted by some one who understood little of the occlusal requirements can be corrected only by opening the bite and re-building the entire masticatory apparatus. Of course much can be accomplished in these cases by doing such grinding as will allow the various movements of the mandible without any tripping teeth.

On page 71 of "Clinical Periodontia," by Stillman and McCall, in a discussion of traumatic occlusion this statement is made: "It should be noted, however, that in cases presenting an extreme overbite of the incisors and cuspids, 'opening the bite' in the bicuspid and molar region may be necessary. This is a precarious problem and fraught with great danger unless carried out with the fullest understanding of the occlusal requirements."

A truer statement was never made. Regardless of how skilled a crown, bridge and inlay workman a dentist may be, unless he can take models of the patient's mouth, get the proper bite, place these models on an anatomic articulator, make a correct diagnosis (as taught by Morton) and see just how much each individual tooth should be built up before he attempts any restorative work, he will, instead of benefiting the patient, destroy the entire masticatory apparatus.

By way of recapitulation in the matter of correcting occlusion: When the teeth are in centric occlusion, all of them should come in contact at the same time, and the patient should get no more trauma from bringing them together than he would get anywhere in his body from sitting down in a comfortable chair. When the protrusive occlusion is normal, the mandible should move forward without tripping over any elongated teeth in the bicuspid and molar region; and when the teeth in the anterior part of the mouth are brought together, whether they be two, four or six, they should come in contact at the same instant, so that the entire force of the bite is exerted on all of the occluded teeth at the same time. When the lateral occlusion is normal, on the right side for instance, the teeth should come out of occlusion on the left side without producing any trauma, and should slide by on the right side without tripping any one or more of them. If the finger is placed in contact with the upper teeth, from the cuspid back to the second molar, and the patient is told to slide the teeth out on that side, a tripping tooth can usually be detected. Articulating paper can then be used to locate the exact point of the tripping and relieve the condition by slightly reshaping the inclined plane, usually on the buccal aspect of the upper tooth. There are exceptions, and sometimes these conditions can be corrected by merely reshaping one or more lower cusps which protrude beyond the line of occlusion. No matter how much work is necessary, one should remember, in correcting traumatic occlusion, never to do anything that will mar the appearance of the patient, and that centric, protrusive and lateral occlusion are of equal importance. Regardless of how one must grind a tooth, it must be done so that, in the various movements of the mandible, there will be no tripping teeth. Any tooth that receives undue stress during these movements is doomed, unless this condition can be relieved.

When the occlusion has been rendered normal and the patient put on the proper diet and taught how to clean the teeth and massage the gingivae, the next step is the treatment of the periodontal pocket.

Traumatic occlusion causes the pericemental fibers to stretch and break, producing a space between the gingiva and the tooth. This space, whether it be 1 mm. or more in depth, constitutes the periodontal pocket. The shallow pocket and the deep pocket must be

treated in exactly the same manner. Furthermore, their treatment should never be attempted except by those who have had special training along this line. Unless the so-called "mild" case of periodontal disease, i.e., the case with the shallow pocket, has its cause removed and is treated so that the gingiva will reattach itself to the root of the tooth, the break, though no more than 1 mm. in depth at the beginning, will continue to deepen until the tooth is finally lost. For this reason, the practice of having the general practitioner of dentistry treat the "mild" cases of periodontal disease and send the advanced cases to the periodontist is the worst thing that could happen to the profession.

The periodontist should have three objectives in view when treating the periodontal pocket: 1. To remove every particle of calcareous deposit and every one of the dead pericemental fibers; thoroughly plane every particle of the exposed root surface without leaving a single scratch, and polish it thoroughly; render the neck of the tooth absolutely normal, and make the crown perfectly smooth and give it a high polish. 2. To remove, to the very bottom of the pocket, the epithelium lining the soft tissues lying next to the root surface. 3. To obtain a blood clot and seal it in hermetically. Then, and then only, can he expect a reattachment of the soft tissues to the root surface and a regeneration of bone.

No matter how deep the periodontal pocket, it is possible, with the two-point contact instruments, to thoroughly plane and polish the root of any tooth without excising the gingiva, without splitting it and laying it back, and without mutilating it in any way whatsoever. Besides, this can be done without leaving any scratches or rough surfaces on the teeth. These instruments will plane only when in two-point contact. When the blade alone is in contact, they will remove calculus, but they will not plane; neither will they scratch the root surface. No matter how skilled an operator may be, he should always enter the pocket with the instrument in contact with the tooth that is to be planed. In planing, every precaution must be taken to prevent undue injury to the gingiva, and extreme precaution should be exercised not to injure the interstitial gingiva; for if this is broken from its labial, lingual or buccal attachment, there will result considerable interproximal recession, and a surface will be left which it will be hard for the patient to keep clean.

When the root has been planed thoroughly, the next step is to polish as far down into the pocket as possible with a very fine, narrow prophylactic strip, this to be followed with silk tape carrying equal parts of moistened oxide of tin and Spanish whiting. When this is done, all of the neck and crown are polished with Arkansas stones and fine cuttlefish disks, the polishing being finished with oxide of tin and Spanish whiting on Young's "B. S." polishers or on moosehide disks. The epithelial lining is then removed from the periodontal wall. Until McCall gave to the profession his sodium sulphide solution, this was a very tedious, painful, exacting procedure, and one in which the operator was never sure that he had accomplished his purpose. But if this preparation is carried on prophylactic silk tape into the very depths of the periodontal pocket and to every surface thereof and is allowed to remain for from five to ten minutes, the epithelial lining can be easily removed by simply reversing the two-point contact instrument. The final step

in the procedure is obtaining a blood clot and sealing it with Box's impervious varnish, thus preventing infection of the clot and at the same time sealing the periodontal pocket. After the soft tissues have been gently pressed into place and a perfect clot (which, if possible, extends as far as the point of contact) has been secured, I dry the teeth, drop a few drops of varnish on the clot, the teeth and the gingiva, and do not expose to moisture for a few minutes. Thus, the clot will be protected until the part which is in contact with the root surface and the soft tissues has become organized. The patient is instructed that he must not massage the gingiva nor in any way interfere with the clot with his toothbrush for at least ten days.

With this technic carried out faithfully, the operator can always expect some kind of reattachment of the soft tissues to the root surface. If, on subsequent visits of the patient, it is found that the reattachment is not perfect; that is, if there is a space between the overlying gingiva and the root of the tooth from which an odor issues, it is usually the fault of the operator. He has failed to (1) obtain the proper occlusal equilibrium, (2) get the root surface perfectly smooth, (3) remove all of the epithelial lining from the periodontal walls, (4) obtain a perfect blood clot and seal it hermetically or (5) give the patient the proper instruction as to how to protect the blood clot during the healing process. When the cause of the failure is discovered, the entire procedure, in this particular place (planing, polishing, removing the epithelium and sealing the pocket), must be repeated until a reattachment is secured.

If the treatment for periodontoclasia is carried out as outlined, and if the patient will acquire and use faithfully the proper technic for brushing the teeth and massaging the gingivae, will adopt a balanced diet and adhere to it strictly and will return to the dentist at regular stated intervals, so that the occlusion can be kept normal, there will be no return of the disease.

For a periodontist to know exactly what he is doing for his patients, it is necessary that he make a complete roentgen-ray examination of the upper and lower jaws before beginning treatment. If he is as careful regarding the welfare of these patients as he should be, he will make roentgenograms immediately after finishing the treatment and once each year thereafter. To the man who does not specialize in periodontia, the roentgenograms made immediately after the treatment is finished will look very discouraging because, the necrotic bone having been removed, the pocket is naturally deeper. But if the periodontist has done his work as he should, the films made one year from the time treatment is completed will show not only a solidification but also a regeneration of bone.

While every patient needs a prophylactic treatment at regular intervals, this is especially true of those who have had treatment for periodontal disease. Dental prophylaxis today means more than merely "cleaning the teeth." It means, first of all, a checking up of the occlusion (by one who knows something about occlusion), and the correction of any changes that have taken place, these changes as a rule being due to uneven wear between restorative work and the natural teeth. A complete roentgen-ray examination should be made at least once each year, not only to detect beginning interproximal cavities, but also to see that there is not any wasting away of the alveolar process owing to abnormal occlusion, and which, when detected early, is easily arrested. In addition to this, dental

prophylaxis should include a thorough examination of the teeth to determine whether any of the gingival tissue has become detached from the root surface. If it has, the surface of the root from which the soft tissues are detached should be thoroughly planed and polished, the sodium sulphide solution used and a blood clot secured and sealed with Box's impervious varnish. All roughened enamel surfaces should be rendered smooth, when a prophylactic treatment is given, and all roughened, abnormal cemento-enamel junctions rendered normal. Then these surfaces should be given the highest polish possible. All of this should be done before any attempt is made to polish the crowns and necks of the teeth with an abrasive.

Periodontitis complex, pericementoclasia, or "true pyorrhea" (the disease is the same, no matter by what name it is called), should never be allowed to occur in the mouth of the patient who visits the dentist at regular intervals. It can be prevented by replacing immediately any teeth that are lost; by keeping centric and eccentric occlusion normal; by restoring decayed teeth to natural form with a material that will stand the force of mastication and hold the points of contact; by retaining the space occupied by extracted teeth, either with a bridge or an orthodontic appliance, which will prevent not only drifting of the approximating teeth but also elongation of the opposing teeth. Dentists who have not yet learned to diagnose, treat and prevent periodontal diseases should close their offices until they have had the necessary training, because, as previously stated, periodontoclasia has become so prevalent and has assumed such enormous proportions that those who have specialized in it are no longer able to handle the situation.

Vincent's infection may be divided into two classes: simple and deep-seated. The simple is that type found when the resistance of the gingivae has become lowered by an excessive carbohydrate intake, by the lack of minerals and vitamins in the diet and by lack of function. If seen in time, before the disease has advanced very far, this type is easily cured by the use of oxygen-liberating agents and by improving the diet (particularly by the addition of vitamine (C.) and by giving especial attention to the sanitation of the mouth. In this simple type of Vincent's infection, the teeth are absolutely free from traumatic occlusion. When the resistance of the gingivae becomes lowered by traumatic occlusion so that they cannot resist the invasion of bacteria, which are always present in the mouth, we have a deep-seated type of Vincent's infection which, regardless of medicinal treatment, will recur or will persist until the occlusion is rendered normal or until the disease merges into other stages of periodontoclasia.

Because the fusiform bacilli and Vincent's spirilla are anerobic, both dentists and physicians have become obsessed with the idea that all that is necessary for a cure of Vincent's infection is a remedy that liberates free oxygen when it comes in contact with the fluids of the mouth. In the case of simple Vincent's infection, this is true, because the occlusion is not involved. In the deep-seated type, this treatment is not sufficient.

The first thing to be done in deep-seated Vincent's infection is to mop the mouth thoroughly with a 5 per cent chromic acid solution, following this at once with hydrogen peroxide, then with one-half teaspoonful of sodium perborate, dropped just back of the anterior teeth. The patient closes the lips, and with the teeth apart, carries the sodium perborate with the tongue to every part of the mouth, allowing it to remain as long as

possible, then rinsing the mouth with warm water. Since acidosis is always an accompaniment of this disease, a large dose of milk of magnesia is prescribed, which will not only correct this condition, but will also cleanse the alimentary tract. Next, the patient is sent to his physician with the request that 2 c.c. of bismuth sodium tartrate[1] be injected into the gluteal muscles. If time permits, on this first day, the patient is asked to return to the office for another local treatment. He is instructed that while at home he must use sodium perborate at regular intervals. If the infection has extended to the throat, one-half teaspoonful of sodium perborate to one-third glass of warm water should be used as a gargle every two hours. The bismuth sodium tartrate should be repeated every other day until all symptoms of the disease have disappeared, which is usually the day after the third dose has been given. It is sometimes necessary to administer the fourth dose, but rarely the fifth. The local treatment should be given twice daily and the home treatment continued until the last dose of bismuth sodium tartrate has been administered.

During the first five days, the patient should not be permitted to brush the teeth, but on the sixth day he may begin, starting on the occlusal surface. He must be warned that when brushing the buccal and lingual surfaces, he must be careful not to touch the affected gingivae. He should use plenty of sodium perborate as a tooth powder, and be sure to boil his brush both before and after using it.

The day after the third dose of bismuth sodium tartrate has been administered, the prophylaxis and reattachment of the gingivae to the root surfaces should be begun, and it should be finished as soon as possible. Ten days is usually all the time needed for handling a case of Vincent's infection. As there is no epithelial lining to be removed from the soft tissues, all that is necessary to get a reattachment is to correct the occlusion, polish the roots and crowns of the teeth and obtain a blood clot, sealing it with the same varnish that is used in the treatment of other periodontal diseases. The patient is instructed as to how to keep the mouth clean without disturbing the clot.

In giving a prophylactic treatment, one should carry dry sodium perborate to the very bottom of the pocket and at the same time remove any serumnal calculus found on the root surface and any necrotic pericementum. Because this part of the treatment is very painful, owing to the fact that the pericementum has not been destroyed, the prophylactic treatment should be given very carefully and as gently as possible. Cases that are treated with sodium perborate carried to the bottom of the pocket during the polishing of the teeth will heal without leaving any evidence that the patient has ever had any form of periodontal disease. When prophylaxis is complete, all impacted and all hopelessly infected teeth should be extracted.

Because a balanced diet plays such an important part in the cure of Vincent's infection and in the prevention of future attacks, the patient should be instructed at the beginning that, until he is discharged as cured, he must drink two glasses of orange juice daily. After he is discharged, one glass a day will be sufficient. He should use milk, fruits, fruit juices and the green leafy vegetables freely.

Until about the tenth day after the treatment has been finished, the patient should continue the use of sodium perborate three times a day after meals.

1. This product has not been submitted to the Council on Dental Therapeutics.

About the eleventh day, he may resume brushing the teeth with his favorite tooth paste or powder after breakfast and lunch, using sodium perborate before retiring. But little pressure should be employed at first in massaging the gingivae, the amount of force being increased gradually. The patient should be kept under observation for a period of ten days after treatment is complete; after which, if he has acquired the proper tooth brushing technic, he can be discharged. Mild cases of Vincent's infection which have not involved a very large area of the gingival surface can usually be cured simply by the local treatment outlined and without the use of bismuth sodium tartrate. If Vincent's infection is diagnosed early and the treatment is finished within ten days, there will be no reason for it ever to have applied to it the term "necrotic gingivitis." If the treatment is faithfully given as outlined and if the patient acquires the proper tooth brushing technic and proper method of massaging the gingivae, keeps the occlusion normal and adheres to a balanced diet, there is no reason for a return of the disease.

Unfortunately, Vincent's infection is not confined to adults. Young children who have this disease will not, as a rule, allow us to apply the chromic acid-hydrogen peroxide-sodium perborate treatment properly. They very often struggle to such an extent that there is danger of strangling and carrying the infection into the respiratory tract. For that reason, it is well that the only thing that needs to be done for them is to prescribe a large dose of milk of magnesia, instruct the parent to give two glasses of orange juice daily until the condition is cured and have the family physician administer 2 c.c. of bismuth sodium tartrate intramuscularly every other day until three doses have been given. Sometimes, but rarely, the fourth dose is necessary. The child is given a balanced diet, with a quart of milk a day, plenty of the green leafy vegetables and a glass of orange juice as a basis. This, with the improvement of the sanitary condition of the mouth, is all that is necessary. No local treatment is needed, and no prophylaxis. After the disease is eradicated all pulpless teeth should be extracted, all cavities filled, and the teeth restored to their normal contour.

For the sake of argument (although I have never encountered such a condition), it will be granted that a case of Vincent's infection can be found in a perfectly healthy mouth with normal occlusion and where the patient is on a normal balanced diet. When a case like this is treated with medicine only, the infection entirely removed and the patient rendered absolutely comfortable, and the gingivae have returned to their normal condition (as far as the none-too-critical eye can judge), a careful examination will show that the gingiva is detached from the approximal surface of every tooth that has been affected. Owing to a slight deposition of serumnal calculus, it will be impossible for the gingiva to become reattached. Unless this condition is corrected by some one who knows something about the requirements for the reattachment of the soft tissues to the root surface, there is no chance for this person to escape the loss of his teeth from some form of periodontoclasia.

(Since writing this article, the treatment of Vincent's infection suggested here has been changed to the extent that, after the first week's treatment, the use of sodium perborate, both as a mouth wash and as a tooth powder, is discontinued altogether. In lieu of sodium perborate, a normal salt solution is employed.)

CONSTRUCTION AND MANIPULATION OF ORTHODONTIC ASSEMBLAGES, WITH SPECIAL REFERENCE TO RIGIDITY*

By EDWARD M. GRIFFIN, D.D.S., New York City

IN consideration of current advancement in orthodontics, it may be noted that the newer science known as "biomechanics" plays a conspicuous part in the literature of the specialty. Orthodontic mechanisms still play an important rôle in the treatment of malocclusion as manifested by the fact that bone develops in response to mechanical stimulation. The mechanical forces utilized during treatment should be in accordance with biologic and physiologic laws. It behooves the orthodontist to give due consideration to the fundamental laws of mechanics in an analysis of type and degree of pressure reactions which may emanate through the tissues in response to adjustments as mechanisms are designed, constructed and manipulated to influence the metabolism of cellular structures.

Orthodontia is in a state of flux, and recognized thinkers in the specialty are advocating appliance assemblages which are at considerable variance in structural design. The increased interest and enlightenment which are fostered by biomechanical considerations have augmented the importance which mechanical stimulation plays as a factor in the study of root resorption; the comparative efficiency of appliances in control of tooth movement in three planes; the proper rate of tooth movement and the speed of treatment; the proper degree and type of pressure; the relative degree of importance of mechanics as compared with biologic studies, etc. One generally conceded theory has developed as a result; namely, that from the standpoint of mechanics, stimulation should emanate from the mechanism as a light even continuous pressure, with reservations as to the possibility of producing such a type of pressure within practical limitations.

It is my purpose, therefore, in presenting considerations in the construction and manipulation of appliance assemblages with special reference to rigidity, to correlate some applications of fundamental laws of mechanics, as shown by an analysis of radically different types of appliance assemblages which are in vogue; to stress what consideration must be given the respective types of construction and manipulation in order that this desirable degree and type of pressure may emanate to the tissues as a mechanical stimulus; and to show, through such analysis of mechanics, that one operator, by certain combinations of appliance designs and appropriate manipulations, may produce a mechanical stimulus similar in type and degree to that of another operator who employs radically different construction in assemblage.

*Read before the Section on Orthodontia at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

It is hoped, therefore, that such consideration may lead to a censensus of opinion in the specialty that due consideration of the mechanical principles involved shall be given to determine what may be desired in the light of reactions arising from the application of appliance assemblages; rather than to an opinion based on prejudice, which seems to exist among groups who are using radically different constructions. If the former opinion characterized the mechanical concept of the specialty, it is apparent that the personal point of view would be dominated by the desire to give due consideration to fundamental mechanical laws as we apply various structural designs, but with the reservation that one basic type of construction

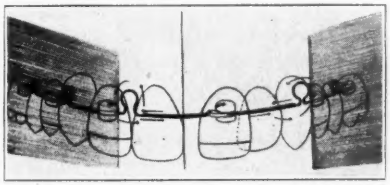


Fig. 1.—Looped section of arch intervening as resilient power arm between tooth to be moved and resistance area. (Griffin, E. M.: Internat. J. Orthodontia, March, 1931.)

or combination may be more satisfactory in the hands of one operator than those of another, particularly since training and experience with a definite technic is so important a factor in reflecting operative ability.

In reviewing the history of appliance assemblage in orthodontics, the transition which marked the advent of the control of bodily root movement of the teeth, as exemplified by the pin and tube appliance and the ribbon arch, was hailed as a remarkable advancement, not only in the light of mechanical achievement, but also because it invited claims of biologic consideration as evidenced by the misconstrued controversy which arose, wherein such devices were characterized as "bone-growing appliances." While it is true that these types of appliances augmented the operator's ability tremendously in the production of bodily root movements under control, as compared with the original type of labial expansion arch with its limited application of stresses, with the improvements in mechanical efficiency ushered in through root control, after years, the light of experience in their use and particularly as revealed by proper roentgenographic examination and check up

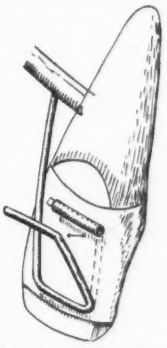


Fig. 2.—J loop extension from high labial arch wire.

of the reactions concomitant with treatment, caused enthusiasm and approval to wane. This attitude resulted from the incriminating evidence to which that type of appliance, employing any form of attachment between the tooth and arch wire for the control of bodily root movement, seemed to be subjected, as compared with the amount of resorption appearing under or following the use of appliances which employed the flexual stress, as the base wire, finger spring application or the expansion arch with ligatures. Also, the advent of removable appliances was hailed as mark-

ing a decided advancement over the nonremovable types from the standpoint of prophylaxis. Again, the light of experience decidedly nullified the advantages which were thought to have been gained. It is impossible in this brief presentation, as a background to the subject for consideration, to give a review of the advantages gained with the resultant disadvantages arising through years of application of the respective assemblages. The subject of particular importance relative to appliances in the correlation of biomechanical considerations seems to be the possible effect which appliance construction, with the attendant type and degree of pressure applied, may have on the production of tissue reactions wherein a condition which is particularly conducive to periodontal disturb-

Fig. 3.—Insertion of loop of lesser gage. (Griffin, E. M.: Internat. J. Orthodontia, March, 1931.)

ance and the resorption of roots, concomitant with treatment, may be induced. This consideration points particularly to the degree of rigidity imposed on the teeth by the mechanism in its application. Conversely, it invites attention to lack of rigidity, with insufficient support to one or more teeth under pressure reactions, wherein the appliance may be considered as insufficiently stable, and resulting in an uncontrollable whip-action in anchorage applications, or the so-called jiggling action, as productive of traumatic occlusion in individual tooth movements.

Albert H. Ketcham, after studying 500 roentgenograms of treated orthodontic cases, correlated his findings with the type of appliances used in the treatment of each case, and thereby invited the assumption that the more rigid appliances may be directly responsible for resorption in orthodontics; i. e., that a condition of immobility is produced which predisposes to resorption of the teeth involved. He also suggests that the resorption may be the result of trauma which heavier appliances produce.[1]

Resorption still defies control as far as any understanding of its direct or predisposing causes is concerned. If it were well known how physiologic resorption progressed, there would be little difficulty in explaining the process of pathologic resorption, but without that knowledge, enlightenment through research, which is being exhaustively conducted on the subject, must be awaited. The study of resorption pertaining to orthodontics invites for consideration many conditions, such as the type of appliance, the order, extent, and direction of tooth movement, the age and health of the patient, the length of time of treatment, the relative susceptibility of localized areas and of individual teeth and the effect of childhood diseases. Thus, it is evident that the type and manipulation of appliance assemblages are only two factors in a consideration of the subject.

The operative skill of the individual is of importance as regards the reactions of the tissues to the assemblage since poor operative procedure with an appliance of such construction that produces less fixation may produce more trauma than an assemblage of distinctly fixed type in the hands of a skilful operator. Nevertheless, with a certain construction, efficient manipulation may

1. Ketcham, A. H.: Preliminary Report of Investigation of Apical Root Resorptions of Permanent Teeth, Internat. J. Orthodontia, 13:97 (Feb.) 1927.

prove more or less difficult to the average operator and the construction may be of the fixed type, wherein the range of adjustment is so limited and manipulation so severe that it would seem an unnecessary and undesirable feature to inculcate in an assemblage.

In the light of clinical experience, as I have previously stated, it has been the desire through resilient arch assemblage[2]:

1. To eliminate rigidity and to employ a light even continuous pressure which is transmitted from the initial moment of setting and is continued for a considerable period of time, either over the entire arch or a limited area.
2. To control slight physiologic like stresses through the application of the elasticity of flexion or the elasticity of torsion to accommodate the range of tooth movements and stimulative reactions as required.
3. That the tooth should be sufficiently supported, but not rigidly bound by a mechanism which permits its movement definitely, directly, slowly, and continuously toward the goal as determined to be its normal position.
4. That the appliance should minimize both immobility and mobility as far as is consistent with efficiency.
5. That the functional activity of the teeth should be interfered with as little as possible.

As stated by H. T. McKeag, in "Physiologic Laws and the Design of Orthodontic Appliances":

> The short thick springs produce the handicap of not giving sufficient amount of movement without repeated adjustments, resulting not only in inconvenience but in loss of continuity of pressure. . . . a series of intermittent stimuli acting over a short range tends to keep the cells in oscillation between rest and action without producing the movement which should result from the action of a single stimulus acting over a wider range. I would suggest that in order to get continuity of stimulus over as much as possible of the necessary travel of the teeth, sources of elasticity should be chosen of such a nature that they give low pressure under larger deflections within the elastic limit. The conditions necessary for this are generally high elastic limit of material, considerable effective length of spring and small thickness of spring.[3]

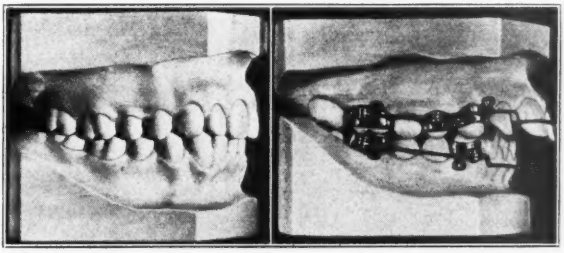


Fig. 4.—Lateral view, resilient arch technic; lingual and labial arches applied cervically on the lingual aspect and incisally on the labial for correcting axial inclination. Excessive number and proximity of attachments should be avoided.

It may seem paradoxical that the resilient arch technic which is expounded here has been deemed as being both insufficiently rigid, that is, lacking in such stability as to render it impractical and that, on the other hand, because of the employment of an attachment for the transmission of pressure between the arch

2. Griffin, E. M.: Physiologic Factors and Mechanical Features Involved in Application of Light Resilient Arch Wires, J.A.D.A., 15:1197 (July) 1928; Technic of Resilient Arch Assemblage, Internat. J. Orthodontia, 17:223 (March) 1931. Vogelson, G. R.: Griffin Orthodontic Technic, D. Cosmos., 74:671 (July) 1932.

3. McKeag, H. T.: Physical Laws and Design of Orthodontic Appliance, Internat. J. Orthodontia, 16:856 (Aug.) 1930.

and teeth, this or any technic which employs attachments other than the terminals of the arches is necessarily an appliance of excessive rigidity. Both opinions are, I consider, the result of misconstrued conceptions which are quite natural deductions, since the resilient arch technic does not employ a heavy base wire, which is said to absorb the stress reactions of the finger springs, and as well, does not employ a comparatively rigid nonlooped arch wire in a dentition every tooth of which is banded and provided with a bracket to effect positive attachment to the arch wire. At this juncture, I offer for consideration the comparative mechanical features involved in assemblages which are at variance in construction in order that a proper evaluation from the standpoint of analysis according to fundamental mechanical laws may be ascertained.

The principle to be avoided of fixation or binding action on the teeth is not dependent on the employment of an attachment which may be considered a more or less precision-fitting bodily root-moving device in itself; nor should any tendency to cause resorption be considered as based thereon because of excessive stimulation resulting, but rather that the important consideration is the degree of rigidity offered by the arch wire itself, whether the force applied through the attachment to the tooth is excessive, and the extent to which the teeth under attachment, during treatment, are interfered with in their functional activity.

The definite construction mechanically of the attachment between the tooth and the arch wire is but one, and a lesser, factor in the production of rigidity in appliance construction and assemblage. If the arch wire itself is employed for the delivery of spring pressure, the exact amount of fixation which is manifested by the attachment mechanism is but one of several factors in the production of rigidity. The construction of the arch wire which delivers the pressure to the tooth or teeth may be such that rigidity or fixation is effected. To illustrate: If the operator is applying a pressure which may be considered a good operative procedure and within physiologic range by rotating a tooth with a simple lever, passing from an attachment on the band, this lever being of a given length, gage and coefficient of elasticity, and set under a certain deflection, the important consideration in adjustment relates to the foregoing specifications regarding the lever and the deflection; which creates the amount of pressure as determined by flexual stress within the elastic limits of the lever. From the moment of de-

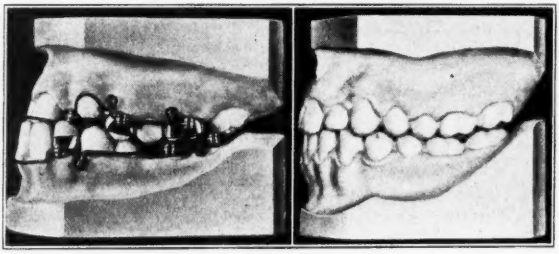


Fig. 5.—Insertion of particularly inflexible section of arch between lower cuspid and molar, used in part in Class III applications.

flection, the degree of rigidity would be only partially affected, as far as the manner of attachment to the band is concerned: whether the lever passes through a tubing tightly or loosely or whether the lever was soldered to the band would be largely a choice in mechanical construction. A consideration affecting rigidity, while the stress for rotation was applied, would be whether the tooth were rigidly bound in position to permit no movement in any plane except as impelled by the direct stress of the rotating lever.

Again, we may consider the application of torsion. To illustrate: If the operator is applying a pressure which may be considered within the range of good operative procedure in applying

Fig. 6.—Early stage in development of resilient arch and alinement wires; illustrating excessive looping; excessive resiliency; excessive banding; insufficient stability to bodily alinement of arch wire, and difficulty in control of reactive forces (unhygienic). (Robinson's appliance, in Dewey, Martin: Practical Orthodontia, Ed. 4, 1919.)

torsional stress to a tooth to change its axial inclination by movement through any plane, the important consideration concerning the adjustment will be the amount of pressure which is produced at the initial moment of application of torsional stress, the time required to exhaust the stress applied (determined both by the resistance offered by the tooth within its investing tissues and the coefficient of elasticity presented by the mechanism within its elastic limits), the frequency of adjustment and the degree of deflection which are subsequently made, rather than the exact mechanical construction of the attachment between the tooth and the power unit. A comparison may herewith be made between the Griffin attachment and the J loop extension from the Lourie high labial arch in torquing the apex of a cuspid root labially, lingually, mesially or distally or in correction from infraversion or supraversion.

The points of attachment bilaterally to the attachment to the tooth to be moved may be considered the area of resistance to the active forces which will

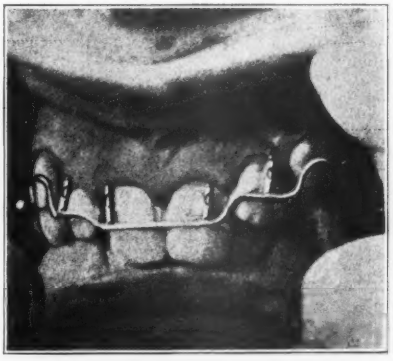


Fig. 7.—Pin and tube appliance. Analysis of the construction indicates that the degree of rigidity would be varied by frequency of attachment; the ratio of resistance offered by teeth to be moved relative to those constituting the resistance area to the adjustment; the gage and coefficient of elasticity of the arch wire; the degree of deflection produced in adjusting the pin within the tube and the degree of precision fit of pin and tubing. The type presents a narrow range of adjustment. (Ketcham, A. H., in Dewey, Martin: Practical Orthodontia, Ed. 4, 1919.)

be created by setting the pressure to produce the tooth movement in the resilient arch technic. Herein, the resistance area bilaterally would consist of group anchorage. In the high labial arch technic,

it would consist of the comparatively stable, rigid and fixed high labial arch. The power arms extending or connecting the tooth to be moved with the resistance area in the resilient arch technic are the looped sections of the arch which extend bilaterally from the attachment block to the attachments of the resistance areas (shown within the shaded areas, Fig. 1). In the high labial arch technic, the connecting medium is the J extension arm dropped from the base wire or the high labial arch (Fig. 2). Herewith, the consideration of rigidity

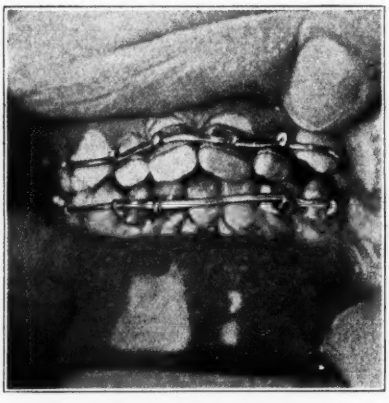


Fig. 8.—Ribbon arch appliance. Analysis of construction indicates that the degree of rigidity would be varied by the frequency of attachment; the ratio of resistance offered by tooth or teeth to be moved relative to resistance area to adjustment; gage and coefficient of elasticity of arch wire; the degree of deflection produced in adjusting the arch within brackets; i. e., number of brackets employed simultaneously and the distance between the attachments. (Dewey, Martin: Practical Orthodontia, Ed. 4, 1919.)

may be shown to depend primarily on the mechanical factors in the intervening or connecting medium between the moving body and the resistance area. It is apparent that any lost motion set up by inaccuracy in fit between the parts of the attaching medium will be expended before the gripping action begins and thus brings pressure to bear on the tooth to be moved. Consequently, a slight amount of looseness between the integral parts of the attachment is ample to permit the tooth to move to some degree in other planes than the direct course of travel as demanded by the pressure of the adjustment. There is a safety valve, so to speak, after the gripping action of the attachment begins, through the looseness provided.

The lesser degree of precision fit in the attachment parts is one factor in the mechanics of the resilient arch technic to decrease rigidity by increasing the latitude of movement in other planes of motion than that which is definitely exacted and expected of the adjustment. However, rigidity is particularly affected in consideration of the nature of the mechanical construction of the intervening medium with the resistance areas.

1. Rigidity is directly proportional to the resistance to deflection of the intervening medium in flexion or torsion when the adjustment for pressure is made.

2. Rigidity is directly proportional to the fourth power of the diameter of the wire: that is, doubling the size of the wire would cause sixteen times the amount of pressure, other considerations being equal.

3. Rigidity is inversely proportional to the cube of the distance that the attachments of the resistance area are placed bilaterally to the primary attachment, as illustrated in the resilient arch technic. In the high labial arch technic, the variation in the gage of the power arm would affect the rigidity as stated for the resilient arch technic, and the power arm would affect flexual and torsional stresses

at its terminal, inversely proportional to the cube of its length.

4. Rigidity would be lessened and influenced by any loop formations depending on the position, size and shape of such loop formations, the formulas concerning which would be complicated in an analysis. It is sufficient to say that the rigidity is greatly decreased by loop formations on either side of the primary attachment and resistance areas, which are always designed in the resilient arch technic. Such looping not only actually increases the length of the wire over the linear distance between attachments but also lessens the rigidity which would be offered in comparison with a nondeflected continuous body wire extending through a series of attachments (Fig. 9).

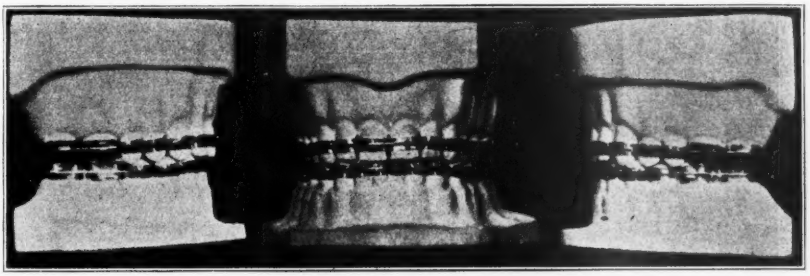


Fig. 9.—Edgewise or horizontal ribbon arch; applications said to enlist every tooth, all moving at the same time. If so applied, the area of resistance and area of tooth movement present reciprocal reactions throughout the dentition. Rigidity is varied according to the number and proximity of attachments used simultaneously; the gage and coefficient of elasticity of the arch wire; the precision fit between bracket and wire; the degree of deflection produced in adjusting the arch wire within brackets, and the resistance offered by teeth within the investing tissues to deflection as imposed by the arch wire within brackets. (Waldron, Ralph: Dynamics of New Angle Mechanism.)

5. Rigidity will be influenced by the coefficient of elasticity of the particular alloy of the wire which is used. While this factor is intimately interrelated with the gage of the wire used, in the resilient arch technic an arch wire of low modulus of elasticity is used to further decrease the amount of force which is released at the initial moment of setting as compared with that of a higher modulus wire of equal diameter. It is herewith apparent that practically every provision possible from the standpoint of the mechanics of construction is provided to produce a mechanism with a limited degree of rigidity, in the production of tooth movements. It is entirely within the judgment of the operator as regards both the nature of the adjustment and the appliance construction to give sufficient support and still produce a minimum binding action on the tooth or teeth to be moved, and thus interfere to a minimum degree with the functional activity, which never tolerates fixation or immobility, but at all times requires a slight degree of individual mobility.

It is essential to state that, provided the mechanism is employed with good judgment, the degree of rigidity may be unreservably limited and the teeth may be subjected to the lightest degree of pressure that could possibly be desired. As stated in previous writings, it is my recommendation that the pressure which is exerted on an individual tooth be limited to about 2 ounces. While it is difficult to

estimate with accuracy the final amount of pressure which is exerted on a tooth under a given adjustment, because that will depend on many variables, it is a simple matter to press a spring balance scale with an instrument to determine by the sense of touch how to produce 2 ounces of pressure within a given range of deflection. Therefore, if the operator produces a pressure of several ounces or even a pound in pressing a block to alinement in making an adjustment in which one tooth is affected as in bodily tooth movement, which amount of pressure would be easily possible with: (1) an improper gage of wire; (2) an improper amount of deflection; (3) an improper form and size of

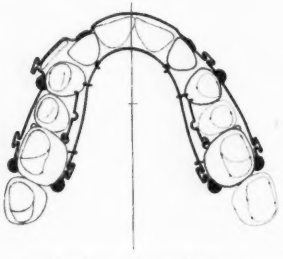


Fig. 10.—Outline of appliance assemblage showing group anchorage and employment of buccolabial and lingual arch construction with attachments. Flexible stabilizers are employed in group anchorage. (Griffin, E. M.: Internat. J. Orthodontia, July, 1928.)

looping; (4) an improper distance of attachment bilaterally to adjustment; (5) excessive molecular tension for spring action, the judgment of the operator is in error and the application of the technic is not correct.

It is a common error for the inexperienced operator to apply too much pressure in individual tooth movements. This is particularly true if the tooth carries an attachment. As shown in Figure 1, it is quite likely that a 0.025 arch wire with the looping shown would be too rigid for the bodily movement of the root and tooth. To provide the proper resiliency in this particular tooth movement, a new loop should be formed of smaller gage wire and tacked by a minute amount of solder over the original loop as shown in Figure 3. The original heavier looping is then cut out at points *A* and *B*, the inserted, lighter loop thus being left continuous with the arch. It is apparent that such looping alinement decidedly reduces rigidity, and it is herewith shown how the tooth to be moved is suspended, so to speak, midway between the areas of resistance so that there is flexibility in all planes as indicated by the arrows surrounding the point of adjustment (Fig. 1), a safeguard which illustrates the pro-

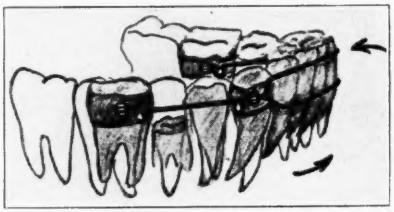


Fig. 11.—Use of double arch wire attached to lower teeth. Extensive root movements of cuspids and axial inclinations of bicuspids and molars should be attained through attachments. All lateral and central incisors, except in extensive root movements, should be corrected by the application shown in Figure 4 or by double arch wire attached to lower teeth as shown here. (Compare Fig. 6.) (Griffin, E. M.: Internat. J. Orthodontia, Ed. 4, 1919.)

vision that no sudden impact shall be imposed on the tooth in any plane. The looped sections bilaterally to the seat of adjustment serve as resilient extension power arms in essentially the same capacity as the extensions in the high labial arch serve as a medium between the tooth and the heavy or base wire which is the area of resistance. This is essentially the

same in any application of mechanics involving the auxiliary spring between base wire and the tooth, provided the spring does not terminate freely, but with the decided advantage that absolute control is maintained through continuity of alinement of the power arms with the rest of the arch which passes through the resistance area. Also, increased efficiency is effected through the absence of a free end to the power arm, the construction making it impossible to maintain uniform pressure when applied except by complicated balanced springs in limited use.

Since the insertion of a more flexible loop may be advisable for extensive root movement of individual teeth, it is apropos to explain that a great deal of actual operative procedure is carried out in the resilient arch technic without placing the spikes through the attachments; that the attachments serve to definitely aline the arch, acting as ferules as the arch slides freely through them during the transmission of force to certain teeth; that the application of the elasticity of flexion, or the ironing out principle, is extensively employed in positioning teeth to proper alinement, as well as tipping them to proper axial inclination through the pressures which are exerted reciprocally between the buccolabial and lingual arches (Fig. 4). It is also infrequently though occasionally essential to insert a particularly inflexible section within an arch in alinement in order that increased bodily resistance to bending may be provided as in Figure 5, while intermaxillary elastics are applied in class 3 conditions, during that time when resiliency is not needed for individual tooth movement. The important point is this: the operator should ever bear in mind that to suit the particular requirements at a particular time and to properly apply a section of assemblage, he should always make such changes in construction as shall render the mechanisms most suitable to requirements. The resilient arch technic calls for those special mechanical applications as accessory to the main assemblage, for variations in the design which are as flexible as the ingenuity of the operator may devise them. Nevertheless, the technic is offered as one of decided standardization.

I maintain, therefore, that the appliances herewith exemplifying the technic of resilient arch assemblage, when designed, utilized and manipulated in adjustments within the ranges of which such practice imposes the technic, may not exert a force exceeding 3 ounces per millimeter of deflection of any individual tooth. It follows that such an appliance cannot oppose the motion of a tooth caused by the masticatory forces, by a force as great as 1 ounce on any tooth unless the motion caused by mastication exceeds 0.5 mm. in a direction directly opposed to the appliance, or a still greater distance in a direction obliquely opposed to it. It is evident that the masticatory forces amounting to many pounds will cause momentary tooth movements, which are not in any sensible degree affected by such trifling resistances as 1 ounce per tooth approximately; i. e., the forces of mastication are of a far greater magnitude than the exceedingly slight resistance which the appliance opposes to these forces.

The foregoing statement pertains to the reaction of forces relative to teeth under stresses during bodily root movement as opposed to the masticatory forces. In consideration of the status of these teeth which serve within the resistance areas under the assemblage to resist the active forces of the adjustment as regards the masticatory stresses, it is apropos to state that if individual anchor teeth are selected as terminals in heavy

arch bar construction, the large gage arches being soldered or terminating in attachments of precision fitting parts to the band, and the active forces as set up through the adjustments of accessory or auxiliary wires are to be transmitted through the heavy base wire to the terminals which are supported by individual teeth, it is apparent that the ratio of forces as induced through stress and resistance is reversed, to the detriment and likelihood of overloading the resistance or anchorage area as compared to the plan of group anchorage opposing the movement of a lesser number of teeth. It is important to state that heavy bars which connect teeth by soldered attachments to the bands or by precision fitting attachments do resist many pounds of the force exerted through mastication. Again, since the technic of resilient arch assemblage is practically always designed with such provision and with the intention of producing a certain amount of tooth movement toward positions of normalcy by the so-called anchor teeth themselves concomitantly with stress and resistance of the adjustment, the more flexible appliance construction is suitable for the control of reactive forces emanating through stress and resistance. Figures 6-11 explain the more important mechanical applications in comparing types of assemblages with consideration of the degree of rigidity which may be manifested and how it may be controlled.

115 East Sixty-First Street.

DISCUSSION

L. B. Higley, Iowa City, Iowa: For the past six years, I have watched with interest the development by Dr. Griffin of the resilient arch technic to its present systematic and efficient form, where it stands, significant, among the best in orthodontic assemblages of today. As stated by Dr. Griffin, orthodontic assemblages, which are at considerable variance in structural design, are being advocated by recognized thinkers in the specialty. I do not propose to discuss the merits of the assemblage advocated by Dr. Griffin as compared with those of other assemblages, but to stress some of his findings which seem important, because, as he has shown, they are based upon purely mechanical laws, the knowledge of which is so essential to the newer science of biomechanics. Dr. Griffin has pointed out that the study of biomechanics has augmented the importance of the following: 1. Mechanical interference as a factor in root resorption. 2. Comparative efficiency of appliances in their control of tooth movement in three planes. 3. The rate of tooth movement and the speed of treatment. 4. The degree and type of pressure. 5. The relative degree of importance of mechanics as compared with biologic studies. One result of such study as has been made on the preceding points has seemingly demonstrated, as Dr. Griffin states, "that the force emanating from any orthodontic mechanism should be a light, even, continuous pressure judiciously applied." In order to show how some mechanisms produce this light, even, continuous pressure, while others fail to produce it satisfactorily, Dr. Griffin has presented a comparative study of several assemblages, endeavoring to point out where they do or do not conform to mechanical laws and has interpreted to us his own and others' findings, the more important of which may be summarized as follows: 1. That, according to Dr. McKeag, "In order to get continuity of stimulus, one should have material of high elastic limit, considerable length of spring and small thickness of spring." 2. That the rigidity of any appliance assemblage is due only in a minor degree to the mechanical construction of the attachment between the tooth and the wire producing the force, whether it be an auxiliary spring or the main arch wire, and that the rigidity of the arch wire itself when used for tooth movement is the most important factor in imparting rigidity or fixation to the entire assemblage. 3. That in order to eliminate undue rigidity in the assemblage and still maintain sufficient rigidity for stability, one must choose an arch wire which is of small gage and low modulus of elasticity and correctly loop it to give sufficient length of spring between attachments, and, as a further caution against rigidity, one must avoid an excessive number and proximity of attachments. 4. That extensive root movements of cuspids and axial inclinations of bicuspids and molars should be attained through attachments, and that all lateral and

central incisors, except in extensive root movements, should be corrected by direct application of the arch wire as described. 5. That the type of attachment between the tooth and arch wire should not be so severe as to produce excessive rigidity. The summarization of these points would seem to indicate that the results of the experience we have had and the research we have carried on, in the department at the University of Iowa, confirm the results obtained by Dr. Griffin. It is impossible to pass over one point emphasized by Dr. Griffin, as one of the results of the study of biomechanics; namely, root resorption. Dr. Ketcham, perhaps, did more to stimulate thought along this line than any other, as he was a pioneer in the study. Up to the time when Dr. Anderson, then a graduate student in the department at Iowa, wrote his thesis on the results of his research on root resorption, no mention had been made of causes other than those due to the type of mechanism used in treatment. It was a part of my work to advise Dr. Anderson on his method of approach to the subject and to work with him on the problems. Regardless of a possible lack of wealth of material used and a consequent possible lack of absolute accuracy in results obtained, we were satisfied that the following points, quoted by Dr. Griffin from the thesis, had a tremendous bearing on the degree of root resorption present and minimized the importance of the effect of the appliance: 1. The length of time for completion of treatment. 2. The order, extent and direction of tooth movement. 3. The age and health of the patient during active treatment. 4. The relative susceptibility of localized areas and of individual teeth. 5. The effect of childhood diseases. 6. The operative skill and judgment of the orthodontist. The reading of Dr. Anderson's thesis is well worth while from the standpoint of methods of approach to such a subject and for clarification of the points listed. At Iowa, the graduate students in orthodontia are taught to use and are made familiar with as many appliances as seem practical, so that they may determine what assemblage is best fitted to perform the treatment necessary for any given case. How much better would it be if, because of the stimulus given by the investigative nature of such men as Dr. Griffin, a research council could be organized. This council, through the research of capable men, reliable in that their work would be for the benefit of the profession rather than for the profit of the individual, would put forth an earnest effort to compile data on the following: 1. A thorough analysis of all essential tooth movements and the type and degree of pressure best suited to accomplish each one. 2. An analysis of the relative possibilities and limitations of the present-day assemblages in producing such movements, with the idea either of evolving a new mechanism or of recommending to the specialty the best in orthodontic assemblages that the profession affords.

CHILDREN'S DENTISTRY IN RELATION TO ORTHODONTIA*

By F. BLAINE RHOBOTHAM, D.D.S., F.A.C.D., Chicago, Ill.

THERE is a need for a better understanding of the term "children's dentistry." Several years ago, an effort was made to find an acceptable term in the Greek derivative "pediadontia," an attempt to supply a dental term analogous to the medical term "pediatrics."

The exact definition of pediatrics is "the science of the hygienic care of children." As hygiene refers to the preservation and promotion of health, pediatrics is clearly an idealistic field of medicine, standing as it does for the maintenance

*Read before the Section on Orthodontia at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

of health rather than the treatment of disease. Although pediatricians care for many types of illnesses, their primary function is to prevent rather than treat disease.

Going farther into the matter of definitions, we find that children are "any young persons at any age less than maturity, but most commonly those between infancy and youth." In the practice of medicine, the pediatrician's field is largely limited to conditions arising in those ranging in age from infancy to adolescence.

Several years ago, a Greek scholar discovered that "pediadontia" was an anomaly as regards spelling, and the term accepted today, became "pedodontia." It is employed to refer to the care of children's teeth.

In medicine, the field of obstetrics includes both prenatal and postnatal care of infants. Prenatal and postnatal conditions have an important bearing on teeth and naturally responsibility for their care falls on the pedodontist.

On the other hand, adolescence frequently begins as early as the tenth year. Although the final shedding of the deciduous teeth often approximates the beginning of adolescence, there is such a wide variance in cases that it is impossible to determine a definite boundary line by age.

For many years, and probably it holds true of today, children's dentistry was regarded as synonymous with the care of deciduous teeth, and only the period after they have definitely erupted.

I have never used the term "pedodontist" in personal reference, for several reasons; first, because the term may not be understood or may prove confusing, and, secondly, because it implies a specialty. The word "specialist" often smacks of quackery. It is, I think, far more dignified to state that a practice is limited to a specific field. I am emphasizing this point because the field of children's dentistry is so limited in background that even those having the longest experience should hesitate to assume the responsibility of the title "specialist."

Ideally, children's dentistry should include all phases of dentistry covering the period prior to maturity and should be the science of hygienic and prophylactic care of the oral cavity. As 99 per cent of all orthodontia is limited to a definite field of work among the same group, it naturally becomes a part of children's dentistry.

The pedodontist's field differs from the pediatrician's in that it opens earlier and closes later. The pedodontist must be concerned with the problems of the obstetrician, for knowledge of prenatal and postnatal conditions is pertinent to proper prophylactic dental care. The pedodontist's care should extend into late adolescence. It would seem feasible, then, to consider that the responsibilities of the pedodontist should include every care and precaution necessary to bring the child to adult life with the best possible oral conditions.

There has been a variety of opinions as to the age limit of patients in the pedodontist's practice. Some have set the age limit at 12, others as late as 18. To carry out an ideal program, it would seem far more reasonable to have a varying limit, dependent entirely on the age at which all of the permanent teeth have been established in their normal fixed positions. Except for the third permanent molars, such a limit might range anywhere between the ages of 12 and 20 years. The later cases are those in which there is abnormal eruption of teeth, particularly bicuspids, cuspids and second permanent molars.

The field of orthodontia has been largely confined to the correction of malocclusion. There is a tremendous field

for so-called preventive orthodontia or, as R. C. Willett of Peoria, Ill., has aptly called it, "interception of malocclusion."

Unfortunately, most of the cases that come to the orthodontist have progressed to such a point that corrective treatment is required. Some conception of the preventive field in orthodontia is had from the research of O. W. Brandhorst, of St. Louis. In a study of 100 cases, he reports that the frequency of occurrence of various etiologic factors of dentofacial deformities is controllable in 81 per cent of cases, while only 19 per cent fall under the heading of questionable. The 81 per cent, he classified as follows: premature loss of teeth, 37 per cent; prolonged retention of deciduous teeth, 19 per cent; habits, 25 per cent.

Regardless of the variation in percentage that might be reported by other investigators or in subsequent studies by Dr. Brandhorst, the fact remains that a considerable percentage of dentofacial deformities could be prevented.

Though there are many other relationships existing between the pedodontist and the orthodontist, the consideration just pointed out marks their common field. In the early periods, it would seem that the pedodontist should assume the responsibility because of his opportunity for initial contacts. In assuming this difficult task, the pedodontist will constantly meet problems which necessitate advice and counsel from the orthodontist.

The few men and women who have dared to attempt to cope with the perplexities of children's dentistry have learned that, with their limited background, they are constantly in need of help. Those that have the association of an orthodontist are indeed fortunate.

A great step forward could be made if the organized groups of orthodontists and pedodontists would together map out plans for mutual assistance. Should such a happy relationship be culminated, it would seem that the first and most important step would be coordination in aid of the general practitioner of dentistry. Compared to the number of children needing dental attention, the number of orthodontists and pedodontists is so pitiably small that adequate care is impossible. Under present conditions, our greatest service to childhood lies with the two groups particularly interested in their dental problems and giving freely of their knowledge to the dental profession at large.

To make such a program effective would require leadership and unselfish effort. There is in existence the "American Society for the Promotion of Children's Dentistry." In the few years that it has been functioning, it has done a great deal of groundwork to the end that its name implies. Though realizing full well the peculiar problems of orthodontists that naturally draw them together in well-defined organizations, I cannot but feel that these problems lie primarily in the field of children's dentistry. There is no need for suggesting any change in organizations, but there is a definite need for closer cooperation between these organizations. Individual effort is too sporadic and requires too much time to change the general attitude on children's dentistry. On the other hand, organized effort would go a long way toward bringing the dental profession to a better understanding of its obligation to children.

There has been so much propaganda by radio, through the press and by public announcement regarding the care of children's teeth that results are beginning to be evidenced. Unfortunately, the reaction is frequently unfavorable. Why? Primarily, because the dental profession has been lax in its preparation to deliver the service which its representatives have led the public to believe is available.

So far, we have limited our thought to the one problem of preventing dentofacial deformities and the dual responsibility to our profession. Let us consider further our relationships as regards responsibility to our patients in common.

In giving dental service during the formative periods, there are several needs that demand special attention. Most important of these is proper guidance. By this, we mean a clear-cut knowledge of the influences that make for normal growth and development of the teeth and their supporting structures. We must keep in mind that a large percentage of the causes of dental ills and deformities are confined to the childhood period. Influences and conditions change so rapidly and these changes are so frequently unobserved that our vigil should be constant. We must be alive to the ofttimes insidious changes that occur without immediate evidence.

Prophylaxis of the teeth goes farther than merely keeping them clean. The question often arises as to the responsibility of the orthodontist in keeping the teeth clean during the period of treatment. In my opinion, the patient's teeth should be carefully examined at every appointment and cleaned if necessary. Should the orthodontist decline to do it, an arrangement should be made to have it done elsewhere. Too much emphasis cannot be placed on the necessity of regular check-ups on bands or removable appliances to prevent harmful effects on the enamel.

Definite instruction as to the home care of the teeth during orthodontic treatment is also essential.

Under the prophylactic care of the hard tissues comes the carefully planned dietary régime, including not only the selection of foods for teeth and bone building, but also those that will best aid functionally.

The prophylaxis of the soft tissues has suffered most from lack of study and application of known facts. Not only are we faced with the knowledge that tooth malposition is a tremendous factor in periodontal disease, but we are also reminded that there are any number of other contributing initial causes that are active during childhood. We need only mention a few of them such as mechanical irritation, careless extraction, the presence of gingival cavities and unextracted roots, careless use of ligatures, mouth breathing and faulty diet. Scurvy is not uncommon even in children of the better class.

In mentioning these common problems of habits, diet and prophylaxis of hard and soft tissues, I wish only to suggest the interrelations of the fields of orthodontia and pedodontia. We must go farther and consider the relationship of the orthodontist and pedodontist to the general practitioner of dentistry.

The pedodontists are so few in number that an organization even of national character would be impracticable at this time. The American Society for the Promotion of Children's Dentistry, which is built around those most interested in the broad field of children's dentistry, is serving a much needed purpose.

Pedodontia has a very limited background. Yet, in the last decade, there has been nothing in dentistry which has received so much attention. Great endowments have come to dentistry largely through the natural human interest that children's dentistry has aroused in the minds of philanthropists. If all of the dentists in America limited their time to caring for children's teeth, they could not begin to cope with the needs. The demand has not arisen, but the public is learning of the benefits and will eventually ask for the service.

In the meantime, we of the profession

must prepare. The plans are already afoot. The dental schools are fitting their students better every year. There will eventually be great numbers of men limiting their practice to children's dentistry because of the demand.

Orthodontia is a definite part of children's dentistry. The need for strict specialization will always keep it a definite unit. The pedodontia of tomorrow may be further divided into other specialties when, and if, the occasion requires. As in orthodontia, this specialization will be limited to the larger communities. All of these relationships may vary, depending on the demands of the future, but regarding the present we are now concerned.

Referring to the earlier part of this paper, may I emphasize that our very present and important function is to urge a closer relationship of the orthodontists and the pedodontists to the end that they may be of *immediate* help to the general practitioner of dentistry.

To make this paper practical, may I unofficially suggest that someone in this Section hearing or reading this paper make an appropriate move to carry out some of these suggestions, should they prove worthy of consideration.

DISCUSSION

John A. McPhail, Cincinnati, Ohio: John Fox in his "Natural History of the Human Teeth" said, "The preservation of the teeth during the continuance of life, is very much affected by the care which has been bestowed upon them during the earliest period. The first set, or temporary teeth, are very liable to become diseased, and they seldom, in the human subject, give way by a natural process in sufficient time to permit the second set, or permanent teeth, to arrange themselves in their proper order, hence the state of the permanent teeth is very much influenced by that of the temporary teeth during childhood, and attention to them at this period is of the greatest consequence, for they may then be preserved from falling into disease, and that irregularity of arrangement which occasions so much deformity may certainly and easily be prevented." This was written in 1803. Today, most of us would agree with John Fox, and most of us will agree this afternoon with Dr. Rhobotham. Despite the fact that much publicity has been given through the written word, in talks to school children, and parent-teacher organizations and over the radio to the importance of preserving children's teeth, apparently only the surface has been scratched. According to reports from the White House Conference, we have in the United States 6,000,000 undernourished children, and more than 1,000,000 with defective teeth. The first person who should be interested and concerned in this great problem is the dentist himself. Emphasis on the value of children's teeth should be made very early in dental college work. It should not be difficult to present in any college clinic thousands of cases showing the disastrous results of premature loss of deciduous teeth. Every dentist sees many of these cases in his own practice. If models were kept of these cases, and were shown to parents who place a low value on children's teeth, it would help them to a better understanding and a greater appreciation of children's dentistry. I know of no orthodontist who is a credit to his specialty who is not enthusiastically in favor of the best possible care of children's teeth. Orthodontists should not only lend their moral support to the American Society for the Promotion of Children's Dentistry, but also both groups should cooperate and coordinate their efforts in promoting this great boon to humanity. On the other hand, if the pedodontists were to form the habit of taking impressions and making casts of the patient's mouth on every birthday until he reaches the age of 12 years, they would have much information that would be invaluable to orthodontists. The orthodontist, as Dr. Rhobotham has said, is consulted after the malocclusion has developed to the point where even parents notice it. We need models of thousands of cases of malocclusion in their incipiency. How many cases of malocclusion correct themselves? Dr. Lewis showed us quite a number yesterday. We need many more to help us in the problem as to what cases of malocclusion in deciduous dentures should be treated, and what cases should be observed from time to time. The term "temporary teeth" has always seemed unfortunate. Parents are very much concerned when they find a cavity in a permanent tooth. Many dentists indicate by temporary

fillings a belief that temporary teeth are of little value. It is no wonder that parents are comforted by the thought that if a child loses a temporary tooth, there is no need to worry about it. A permanent tooth will take its place.

NERVE REFLEX DISTURBANCES OF DENTAL ORIGIN

By L. R. MAIN, D.D.S., St. Louis, Mo.

IN the practice of radiodontia, many unsuspected indications of pathologic processes are revealed as a result of efforts made to restore lost organs of mastication. It is well to have an occasional check-up on the result of root canal work, surgical procedures or restorations, but such is not the purpose of this paper. I wish to stress the importance of diagnosis in the face of dental problems, as no dental disturbance is a local problem in the final analysis.

Fig. 1.—Unusually large incisive or anterior palatine foramen, a landmark of interest to dentist.

Ten or twelve years ago, the radiodontist was expected to speak on some phase of oral diagnosis. Then progress, further information and a general acceptance of roentgenographic evidence by the profession as well as by the public and the use of the roentgen rays in the average office seemed to demand that technic in radiodontia and interpretation be emphasized. In this paper, I am returning to the old subject of diagnosis, but approaching it from a new angle, stressing not what is frequently found as a result of operative dental procedure, but what is sometimes found in nature and over which man has little or no control.

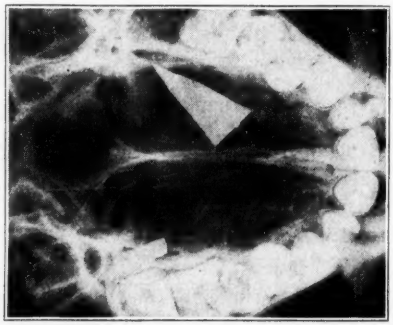


Fig. 2.—Incisive foramen and posterior palatine foramina as shown by lead markers on dry skull; anatomic landmark of interest to dentist.

I shall speak on general nerve reflex disturbances of dental origin. The literature of today is alive with articles on every conceivable phase of dentistry and all kindred topics, except this particular subject, and on this phase of pathology I am unable to find any special contribution to our journals. After observing many of these cases for years, I am convinced that the frequency with which general symptoms arise from nerve irritation as a result

of pressure is sufficient to warrant spending some time on this subject.

May I digress to correct some impressions which are accepted by dentists on the whole as truisms, but which are built on false conceptions. One is that if the teeth are not abscessed, they should not be considered as factors in general complications. Another is that if they respond to the vitality test, they are safe; and, again, if all the teeth have (apparently) been removed, further examination by the dentist is unnecessary. Some are of the opinion that all disease is the result of the presence of micro-organisms somewhere in the body. It took the dental profession a long time to acquire an "infective sense," for which Dr. Price used to plead fifteen years ago, but I find it is difficult now to realize that other conditions than infection can be factors in general complications and that some of these factors are for the dental profession to solve. This inevitably means more care in diagnosis and a broader conception of dental pathology than is now held by the average physician and dentist, and further consideration of general pathology.

Nerve reflexes immediately suggest a rather complex subject, yet every dentist is quite familiar with referred pain along the entire course of the trifacial nerve. These pains are not truly reflex disturbances. In reflex or sympathetic neuralgia, the pain is felt in another nerve region than that in which its cause exists. In a true sense, reflex neuralgia has no sensory continuity with the primary pain. The proneness of the fifth nerve to be affected in neuralgia renders it a common seat of reflex form, owing to its vast and varied distribution. It is the largest and perhaps the most complicated of the cranial nerves and its intimate relation with the teeth

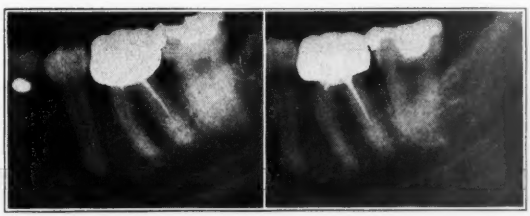


Fig. 3.—Mental foramen and mandibular canal as landmarks of interest to dentist.

Fig. 4.—Pressure on posterior palatine foramen causing head noises and neuralgia.

Fig. 5.—Pressure on anterior palatine foramen causing headache.

makes it unique in function and also in abuse. Because of its location in innervating the head and face with sensory fibers and also the motor supply to the muscles of mastication, in every dental operation this nerve must of necessity be reckoned with, and the rhinologist is continually dealing with neuralgia of trifacial origin. I doubt that any nerve in the entire body is subject to such trauma as is the trifacial, and yet in spite of what seems to be necessary abuse, there is really little unfavorable reaction. In neuralgia of the face and head, the fifth nerve is invariably involved, and many times these cases are of dental origin, but sometimes of nasal or sinus. Some cases are unexplained; and especially is this true in genuine cases of tic douloureux, as the cause of this dreaded affliction is unknown, and no other nerve condition gives rise to such a train of symptoms.

Fig. 6.—Pressure on anterior palatine foramen causing headache.

Fig. 7.—Pressure of impacted cuspid on central incisor causing wryneck.

There is considerable in medical literature concerning reflex disturbances in many parts of the body, such as conditions developing from intracranial pressure as a result of brain abscesses and tumors. An important class of reflex pains are those which are produced by diseases of the viscera, such as spinal pain in gastric ulcers, sacral pain in uterine diseases, scapular pain in affections of the liver, pain in the testicles in renal colic, pain in the front of the thigh and spine in some cases of gonorrhea and a form of headache from pressure of the uterus on the spine. There is neuralgia as a result of injury which plays a part in referred pains, and, in some cases, reflex pain develops as a result of trauma, due to the implication of nerves in a cicatrix. Occasionally, this condition is the result of oral surgical work and placing den-

Fig. 8.—Case in which occipital headaches were relieved when opening was made into lateral incisor and hemorrhage resulted.

Fig. 9.—Case of otalgia relieved by removal of third molar.

tures on ridges which are not properly cared for.

In dental literature, practically nothing is found on the subject of reflex complications, but I am convinced that there is much information available, if we are alert as to the subject, chiefly because of our work being confined to the most complex nerve in the body, the trifacial. This has been called by some writers the most difficult and complex piece of nervous anatomic structure to master and understand. Its location, distribution and function offer many problems and its relationship to other cranial nerves is most intimate. Its function in relation to normal dentition is unique and all phases of dental disease can and sometimes do

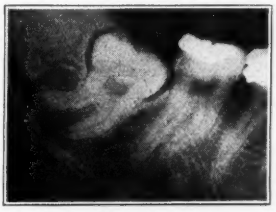


Fig. 10.—Case of headache and otalgia relieved by removal of third molar.

present conditions which are foreign to other nerves. Slight or major irritation of this nerve is common in most minor dental operations. In dental and oral surgical work, traumatic injury to nerve endings and sometimes to the main branches, especially the third division, is rather common. We wonder what provision Nature makes when factures of the mandible, the maxilla or the skull take place, and why such serious injuries do not result in various reflexes. This question has not been satisfactorily answered as far as I know. Francis Anstie, a noted English physician, who is quoted much on diseases of the nervous system, had this to say: "Neuralgias are more common following only a slight injury to a nerve, than when nerves are completely divided, as is found when nerves are slightly injured in gun shot wounds, then sometimes the pain is referred to parts, supplied by other nerve trunks."

Of course, we are familiar with sympathetic pain in a pulpless tooth when a pulpitis is present in another tooth and also as a result of pulp nodules in some other tooth. These pains, while reflex in a measure, are not typical but are due to nerve continuity. In the past fifteen years, attention having been riveted on the pulpless tooth and its sequelae, it has become difficult to realize that general symptoms can develop from any other dental source than a septic tooth. The vitality test is a necessity in the office, and this valuable adjunct is used on about nine out of every ten patients for whom I make roentgenograms. Valuable as it is, we cannot depend on it or any other mechanical device as being absolutely dependable for giving all the information desirable in every case. The habit of using this test and then roentgenographing only a few of the teeth which respond unfavorably is bad practice in the majority of instances when there are general symptoms. This again indicates that we believe infection only can be responsible for general complications. To make an intelligent diagnosis, we must, if possible, have all the facts before us, and then make our deduction according to these findings. Our recommendation should be as rational as we would expect those of a medical man dealing with the case to be. Dentists must spend more time and effort in diagnosis if they are to cope with the ever enlarging responsibilities of health which involve the profession.

The intimate relationship between septic teeth and general symptoms is accepted as a fact no longer to be estab-

lished. But what are some of the symptoms which may develop as a result of irritation of the fifth nerve and where infection does not necessarily play a rôle? First, we should always be on our guard when certain symptoms are presented without any discoverable exciting cause, especially if an effort has already been made to eliminate the usual foci. All cases of headache should be seriously considered. In using the word "headache," I do so with considerable reservation, as the term itself means little, and yet patients use it to describe almost any type of pain about the head. There are many types as well as many causes for so-called headache and most of these disturbances are not of dental origin. Still, the teeth are sometimes responsible for this train of symptoms, as a result of infection or owing to pressure caused by impactions, the presence of root fragments or supernumerary teeth, migration of teeth, etc., and it is the latter group that we are now considering. It seems that these reflex disturbances are more frequently found in the occipital region, though occasionally they are observed in the parietal region. If headache, earache, certain eye symptoms, gastric disturbances, etc., develop with no apparent cause, it is well to consider the possibility of reflex disturbances. Our usual habit of making partial examinations, and therefore securing limited information, and giving a report which is very incomplete, must be discouraged when patients are referred with symptoms which persist after an earnest effort has been made to give relief. We are sometimes inclined to ascribe too much to the patient's being a neurotic, without doing our full duty to determine some probable cause for the neurosis. An occasional discovery of nerve pressure, which is responsible for any morbid condition, certainly warrants thorough investigation as long as there is any possibility of the teeth being involved.

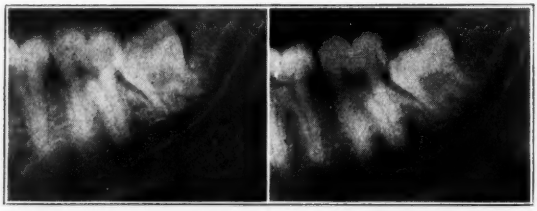


Fig. 11.—Case of headache relieved by removal of right mandibular third molar.

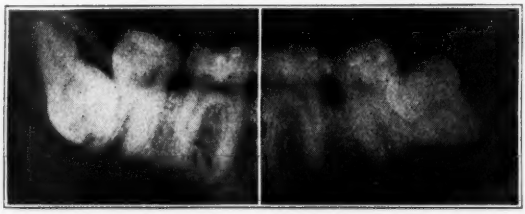


Fig. 12.—Case of severe headache relieved by removal of impacted molars.

There are many things about the

human body which cannot be explained, and many conditions develop which affect the whole nervous system and which are not thoroughly understood, but an effort at reasoning out some of the phenomena which we find is interesting. A few years ago, after a number of symptoms cleared up on removal of the suspected cause, which I had attributed to pressure, a thorough review of the cranial nerves was suggested. Their origin, distribution and function was, of course, interesting, but also the relationship which exists between the cranial, the cervical and the sympathetic nervous system and their intricate communication was also of interest. This study proved to be most complex, for sometimes no explanation for general symptoms could be offered which would satisfy the skeptical. A satisfactory theoretical explanation is sometimes possible, as in the case of suspected tympanitis, when a pulpitis in some tooth or pressure from a calcifying third molar is responsible for what seems to be an earache. As the third division of the fifth nerve, through its auriculotemporal branches of communication, innervates the meatus auditorius as well as the tympanic membrane itself, it is easy to imagine these symptoms in such a case, owing to nerve continuity, which, of course, is not the result of a true reflex. In origin, the twelve pairs of cranial nerves in the brain are closely associated, but I believe the reflexes are due to their distribution and intercommunication, which is, in a sense, made more complex by the presence of the sympathetic nerve. We satisfy ourselves sometimes by attributing to the sympathetic nervous system many conditions which are otherwise unexplained. I mentioned that many dental irregularities are reflected to the occiput. This may be due to the rather superficial distribution of the great occipital and other cervical nerves and their blending with the third division of the fifth in innervating some of

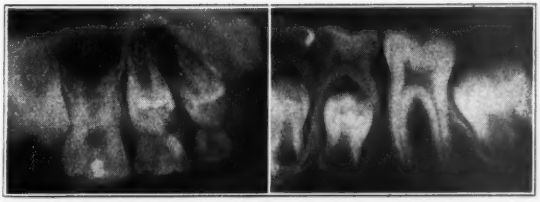


Fig. 13.—Case of gastric disturbance relieved by extraction of eight temporary molars.

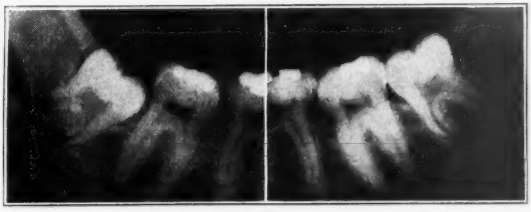


Fig. 14.—Case of headache, gastralgia and dysmenorrhea relieved by removal of two impacted third molars.

the same structures of the scalp. This I have construed as a possibility. Explanation of other symptoms in more remote parts of the body offers more difficulty. Gastric disturbances can be and occasionally are the result of reflexes probably brought through the tenth or vagus nerve. The tenth nerve, which has a more extensive distribution than any of the cranial nerves, is both sensory and motor. It supplies branches to the ear, pharynx, larynx, heart, lungs, esophagus and stomach. It has been intimately associated with the so-called diseases of primary dentition, but is rarely ever considered seriously in permanent dentition. Years ago, the normal process of dentition was considered a very potent factor in gastric derangement, general fretfulness and fever in very young children, and sometimes these symptoms did develop, being due probably to reflexes through the pneumogastric or tenth nerve. In most instances, when these symptoms were present, they were due to faulty diet. These cases of dentition are seldom seen by the family dentist in young children, but are taken care of by the pediatrician. As our knowledge is fragmentary, the modus operandi by which symptoms develop elsewhere in the body owing to irritation of any of the branches of the trigeminus nerve is somewhat speculative, but the results obtained are so definite in some cases that further consideration of reflex disturbances from the dental viewpoint should be most interesting, challenging us to further research.

The possibility of general complications as a result of trifacial reflexes and neuralgia only adds to our responsibility and the necessity of giving more time to secure case histories and to make a diagnosis which is complete. I mention the case history to stress the necessity of this information if we are to reach conclusions and make intelligent recommendations. The simple fact that a third molar is impacted is not always sufficient to suggest its removal even though we are certain that pressure is exerted on the mandibular canal. But if such a condition is found in a person about 23 or 24 years of age, with a history of unaccounted for headaches or ear disturbances of four or five years' standing, surely recommendations must be colored by this history. One of the weaknesses in which most of us share is paying too little attention to the general health and another is lack of cooperation with medical men to the degree of fully representing the dental angle in a given case. As no group of men is better qualified to understand this part of the nervous mechanism than are the dentists, we should

Fig. 15.—Third molars forming around and on the mandibular canal.

avail ourselves of every possible bit of information in making a diagnosis of cases, especially when there are symptoms which could be of dental origin. When the diagnosis is incomplete, the information secured is limited and therefore definite conclusions on a rational basis are impossible. If our minimum effort is to provide the maximum of health to our patients, that effort must be based on thorough oral diagnosis.

The following roentgenograms show where pressure has been exerted on the trifacial nerve and as a result of this pressure disturbances have been manifested, chiefly in parts supplied by other nerves. When general symptoms develop as a result of this condition, it will usually be found that the pressure is from a calcifying tooth (frequently the mandibular third molar), an impacted, a migrating or a supernumerary tooth, an osteoma and occasionally a cyst. The point at which the pressure is usually exerted is at a foramen or directly on the mandibular canal. I wish to again stress the point that, in all the films shown herewith, loss of bony structure as a result of infection does not enter into the question in any sense, pressure only being considered.

A brief review of the cranial nerves is always helpful, but in connection with the paper presented, a consideration of the origin, function and distribution of the trifacial, vagus and the cervical portion of the sympathetic nerve is urged.

Figures 1-3 show important anatomic landmarks of special interest to the dentist, indicating where impingement on the trifacial nerve by impacted or migrating teeth, etc., takes place.

Figure 4 shows a case of suspected pressure at the posterior palatine foramen. The patient complained of tick-like noises or sensations in the left ear of one year's duration and which made her very nervous. She also suffered from severe supra-orbital neuralgia. Pressure at the posterior palatine foramen was suspected. Removal of the second and third molars (which were fused) relieved all symptoms.

Figures 5 and 6 show two cases of suspected pressure on the anterior palatine foramen. In Figure 5, the patient, a man, was about 50 years old. Removal of the cuspid gave almost complete relief from chronic headaches. Figure 6 is from a case in which a patient, aged 44, was relieved of headache by removal of supernumerary teeth, one of which appears in the film to be directly at the foraman.

Figure 7, a roentgenogram made in 1916, shows an upper left central incisor that was under treatment for months, but the tooth remained sore in spite of all efforts. In desperation, it was extracted, with the result that a bad case of wryneck, which had persisted for three years, immediately disappeared. The roentgenogram made some months after the extraction revealed impacted cuspids. Evidently, pressure of the cuspid on the central incisor was responsible for the symptoms.

Figure 8, a roentgenogram made in 1917, is from the case of a nurse who suffered from occipital headaches which could not be explained. An opening into the lateral incisor revealed a partially vital pulp and a most profuse hemorrhage followed. In about thirty minutes, pain in the occipital region subsided.

Figures 9-10 are from cases in which symptoms of otalgia were the result of pressure on the mandibular canal. In the case illustrated in Figure 9, removal of a third molar corrected an earache that had been unaccounted for. In the case illustrated in Figure 10, in a patient aged 23, headaches of three years' duration and left ear disturbance disappeared on removal of the third molar.

Figures 11-12 are from a case of headache resulting from pressure of the third molar on the mandibular canal. In the case illustrated in Figure 11, an unaccounted for headache of four years' duration was relieved by removal of the right mandibular third molar. In Figure 12, impacted teeth were removed with gratifying results. The patient, a clergyman, aged 36, had thought of giving up the ministry because of severe headaches of years' standing. Examination at a great medical center had afforded no results. He was able to continue with his work after removal of the offending teeth.

Figures 13-14 are from cases of unusual gastric symptoms and other complications. Figure 13 is from the case of a boy, aged 11, who experienced immediate relief of a marked gastric disturbance of four months' duration on removal of eight temporary molars. In the case illustrated in Figure 14, a university student, aged 20, suffered from headache and gastralgia, and had had dysmenorrhea for eight months so severe that it was necessary for her to spend four or five days in bed each month. All symptoms disappeared on the extraction of the two unerupted third molars, pressure from which was suspected.

Figure 15 shows how some third molars form around and on the mandibular canal.

THE NEED FOR COMPREHENSIVE RESEARCH INTO THE CAUSES OF DENTAL CARIES*

By ALFRED WALKER, D.D.S., New York City

IT is with some trepidation that I present to the Trustees and the Research Commission of the American Dental Association a suggestion for a plan of scientific investigation. This is because I do not consider myself a research worker. However, it is my belief that one looking on this field from the standpoint of a highly interested clinician may have some suggestions to offer which may have value, if only from the fact of their coming from a source outside the ranks of the laboratory research group.

Those, namely, the general practitioners of dentistry, who have to deal with the results of caries in the human mouth are in a position to evaluate the situation with regard to this disease in a different degree from that possible with even the dentists who are conducting laboratory research. In this group, I include those who are conducting experiments on children in institutions. Do not get the impression that I am depreciating the importance of laboratory investigation or institutional experiments; each has its place in the plan which I have in mind. Having followed the literature on this subject for many years, and having made careful clinical observations during the entire period of my practice, I have reached the conclusion that what is now needed is a coordinated study of the

*Presented to the Board of Trustees and Research Commission, Buffalo, N. Y., Sept. 13, 1932.

subject which shall embrace all of the research which has been carried on, together with certain other studies which I shall suggest. It is my belief that only by bringing together the results of studies relating to caries, made from all possible angles, shall we arrive at a solution of this problem.

In my opinion, what is needed first of all is the employment of a research director. This individual should be one thoroughly grounded in research work, and while we have in the dental profession many competent research workers, I feel that it would be better to seek the services of someone whose activities have covered a broader field. It would be the duty of this director, first, to bring together in concise form the results of investigations so far reported. It would also reduce to concise form the observations on caries as regards immunity and susceptibility thereto in various racial groups and geographic areas. These observations would include the items of food habits, climatic conditions, water supply, personal hygiene and community sanitation, housing conditions, susceptibility to other diseases and such other conditions as might be considered to have a possible bearing thereon.

Under clinical observations, there would also be brought together information regarding incidence of caries in families, both as regards similar and dissimilar susceptibility and localization of carious surfaces in the individuals' mouths. There is also to be considered the question of the relation of age to susceptibility.

It will be readily appreciated that the proposed director, having assembled this material, will next make an effort to correlate the information so gathered with the idea of consolidating such relationships as might thus be established. The director would then develop a plan for research in which all apparently pertinent elements might find their appropriate place, and, under this plan, would assign certain problems to each research worker or group, with the injunction that each particular problem be studied in the light of its relationship to the plan as a whole.

It remains only to summarize briefly the present situation in this department of pathology, to make clear why I urge the adoption of this plan. In the first place, may I call your attention to the fact that the American Dental Association has, through its grants, disbursed more than $300,000 in about twenty years for research in dental problems largely related to dental caries?[1]

Other research has been carried on either with or without subsidy from interested individuals or organizations, the total expenditure in this country reaching a very respectable figure. I do not complain because the studies carried on through the expenditure of this money have found us still short of the goal, but I do believe that it is time we recognize the complexity of the problem, and I feel certain that, as a result, we will do no less than to take steps toward the wisest possible allocation of effort and money in future researches.

Let me now call attention to the work of only a few investigators. We may well start with Miller, who was the first to give a laboratory demonstration of the actual origin of clinical caries. Then we have Low, of Buffalo, Gies, in New York, Bunting, Howe, Bödecker, Hawkins, Boyd, Drain,

1. Commonwealth Fund, first year, $35,600; second and third year, $32,300 each for Columbia; Carnegie Grant, $100,000, University of California Dental Dept.; Rockefeller Foundation, $100,000, Rochester.

Hane, McCollum, Rhein, Mellanby, Eddy and others. The work of these investigators is known to all of you and need not be reviewed here. What I wish to call to your attention is the fact that each of them has studied the problem from one standpoint. Thus, we have studies of diet including vitamins, bacterial influence, internal tooth factors, histologic structure and calcium and phosphorus metabolism. Each of these studies has yielded important results and has been of undoubted value, but the fact remains that none of these investigators has made an effort to correlate his work with that of others in the field, or to apply the results of their work in his own investigation.

Let us now turn to the field of clinical observation. We have numerous reports from various parts of the world emanating from trustworthy observers as to the incidence of caries in various races and in varying climates and other general environmental conditions. As far as I know, there has been no serious effort to analyze these observations with the idea of seeking common factors in regard to either immunity or susceptibility. Furthermore, there seems to have been no attempt to correlate these observations with the facts brought out in laboratory research, which I have previously mentioned.

We next come to the field of clinical observation in the mouths of individuals in this country. Here, we have a mass of material available which is of the utmost value if it can be brought into an orderly presentation. I refer to such observations as those relating to the susceptibility of brothers and sisters, in which great variation is often found; similar susceptibility or immunity in parent and child; susceptibility in age groups, and other frequently observed susceptibility relationships. I would particularly call attention to the immunity of certain surfaces with regard to location in the mouth. The latter point is one which has received too little attention in past discussions of the subject. We should be as much interested in localized immunity as in susceptibility. These observations, when properly reduced to order, should also be subjected to the process of correlation with other information available. It is my belief that when all this has been done, there will almost automatically present itself a concept which may be made a subject for future investigation.

By way of clarifying my position in this matter, it may be in order to call attention to certain observations of phenomena which are familiar to all of you but which have, I feel sure, a significance not usually assigned to them by the laboratory research worker. For instance, we note that, except in few instances, teeth are not prone to decay on surfaces and parts of surfaces that are readily accessible to natural cleaning. Naturally, this suggests, at least, that internal conditions are not the sole controlling agency in immunity and susceptibility. Furthermore, we note that surfaces known to be susceptible to decay, such as the proximal surfaces, only exhibit this susceptibility when actually approximating an adjoining tooth. When the teeth are rotated or spaces exist, typical decay of the true proximal surfaces does not occur. This rules out a possible anatomic influence.

Another observation worthy of consideration is the fact that age has a bearing on susceptibility. Dentists are familiar with the fact that the period of greatest susceptibility is the earlier years of life, but that other periods of susceptibility sometimes are evidenced. Too little attention has been given to the very noticeable immunity of the

lower anterior teeth in the great majority of people, even when all other teeth in the mouth are subject to the carious process. This immunity is not related to either natural or artificial cleansing processes.

There has been a tendency in certain quarters, in late years, with the growing interest in the influence of diet on the teeth, to minimize the value of the toothbrush as a means of preventing or restricting caries. I am convinced that the vast majority of dental practitioners who have given thought to this subject will agree that conscientious use of the toothbrush is a great aid in reducing caries. If this is so, it is an indication of the possibility of controlling caries by influencing environmental conditions and that this subject is one which deserves inclusion in a comprehensive research program.

There have been some scattered observations as to the influence on caries of reduction of flow of saliva and the secretions from the glands of the buccal mucosa. An unnatural dryness of the mouth may prove to be a more important influence than has so far been realized. Another local condition which has been given but slight consideration from the research standpoint is the preservative influence of correctly executed filling operations. The influence of such operations on the general conditions of the mouth should be given equal weight with their influence in the restoration of tooth form and function. Their influence on the pulp and its possible functions is also worthy of mention, as is also the fact that pulpless teeth are, in the majority of instances, no more prone to decay than are vital teeth similarly situated in the mouth. All of these facts have a definite bearing on the question of the relationship of environmental to systemic conditions in conferring immunity to caries.

In conclusion, may I refer once more to my original suggestion, which is that a director be appointed to coordinate available information regarding dental caries, and to develop a comprehensive and integrated program for the future study of this problem. The first task of the director would involve a review of the entire literature. This in itself is a stupendous undertaking and would require considerable time, but is an essential first step.

HOW TO TEACH THE PUBLIC ABOUT THEIR TEETH

By LORD RIDDELL, London, England

THE title of my address is "How to Teach the Public About Their Teeth." You will, I am sure, agree that they require teaching. As a nation, we have nothing to boast of in the matter of teeth. Sound teeth, to say nothing of good-looking teeth, are the exception and not the rule. Sir George Newman says "Dental decay is universal." I may add that it stalks through the land like a horrid specter. It causes a vast amount of human suffering, and is responsible for a vast amount of human ugliness. The truth is that the majority of the public take little interest in preserving their teeth. Perhaps it is

not surprising that the hygienic point of view is overlooked, but it is surprising that a large section of the community fail to appreciate the esthetic point of view. From time immemorial, beautiful teeth have been a valuable feminine asset. King Solomon, who may be regarded as an expert, included in his inventory of feminine charms fine teeth and sweet breath. Who can have a sweet breath with bad teeth? Notwithstanding this great tradition, comparatively few women pay due attention to their teeth. They are willing to spend money on dress and jewelry, but grudge dentists' fees. Men are even more neglectful. Many go to the dentist only when driven by toothache.

Teeth receive little attention in the press. Now and again one sees a stray paragraph recording some more or less humorous or tragic incident connected with dentistry, but one seldom sees a serious, reasoned argument in favor of better attention to the teeth. During the last few weeks, I have read four paragraphs which are good instances of the dental news which excite popular attention. The first related to a Scottish Police Court case regarding an assault, in which much was made of the fact that the accused had taken out his false teeth and put them in his hat before attacking the prosecutor. This was described as an instance of Scottish caution and economy. The second related to Mr. Gandhi's dental troubles; the third, to a remark made by M. Clemenceau, who is reported to have said before his death that, although his friends had deserted him, he still had his teeth and could bite, and the fourth, to the case of a female lunatic who had been cured by the extraction of six septic teeth. Some time ago, when dealing with a similar case, in which the poor demented woman was under the delusion that she was the Queen of Sheba, I rather questioned whether it was worth while to extract her septic teeth and thus bring her back to the unromantic fact that she was a laborer's wife with six children; her husband being out of work.

However, this is an ethical question which, happily, does not come within my province on the present occasion. I only mention these cases to illustrate my point. Of course, novelty is the essence of all news. As a distinguished editor once said, "If a dog were to bite a man, it would not be news; but if a man were to bite a dog, it would!" The trouble is that dentistry, as usually presented, is a very dull and unromantic subject—I might almost say a painful one; which explains why so little serious dental comment appears in the press or in periodicals.

All doctors are agreed that preventive medicine is the most important branch of medical work, and most agree that dental attention is one of the most important branches of preventive medicine. We hear a great deal about campaigns and methods for the prevention and cure of cancer, tuberculosis and diabetes, but we hear little about the benefits that would be conferred on the community by increased dental attention. There is nothing in the shape of a wide-spread, vigorous dental campaign, although it is evident that improvement in dental conditions would obviate an enormous amount of disease and discomfort. When speaking to an audience composed of experts, it would be impertinent for a layman to go into details. Suffice it to say that good teeth are the elixir of life. In short, dentistry, considering its vital importance, does not hold its proper place in public estimation.

It is true that the school medical service provides dental treatment for children aged from 5 to 14. Apparently, it

is only possible each year to examine about half the children attending elementary schools and to treat two-thirds of the inspected children requiring dental treatment. The number of children referred for treatment in 1930 was about 2,000,000, and the number actually treated about 1,250,000. The work of the dentists employed was equivalent to that of only 521 whole-time dentists, so that each dentist had to deal with about 4,000 children. To provide a complete school dental service, more than 2,000 whole-time dentists would be necessary. These figures show that, in the schools, the amount of what you dentists call "conservative work" must necessarily be very limited. In some districts, provision is made for treating the teeth of children under 5, but the work done is negligible, considering the size and importance of the subject matter.

One is bound to admit regretfully that comparatively few parents recognize the need of dental treatment for their children, and that many are definitely and resolutely opposed to it, mostly on the ground that unnecessary pain will be inflicted on the child.

At the age of 18, the National Health Insurance Scheme begins to operate. It contains no provision for dental treatment, but certain approved societies having surplus funds supply their members with treatment as an additional benefit. The annual sum available for this purpose is about £2,000,000. This sounds a large figure, but, considering the immense number of persons to be treated, for practical purposes the amount is not so large as it looks. Indeed, it is hopelessly inadequate. As a result, much of the work done is unsatisfactory, particularly the dentures supplied, both as to fit and appearance. The teeth in many of these look very much like gravestones, no attempt having been made to suit the wearer's physiognomy. The teeth are blatantly badged as false. Persons who do not come under the National Health Insurance have to make their own dental arrangements.

I now come to the most glaring defect in our public dental scheme. Except in the case of scholarship students in secondary schools, there is no provision for attending to the teeth of young persons between 14 and 18, a most critical period dentally. In consequence, much of the school dental work is wasted. Indeed, Sir George Newman says in his last report, "It is a remarkable fact that among the insured persons examined, very little evidence has been found of dental treatment having been carried out during school life." No wonder that we as a nation have bad teeth!

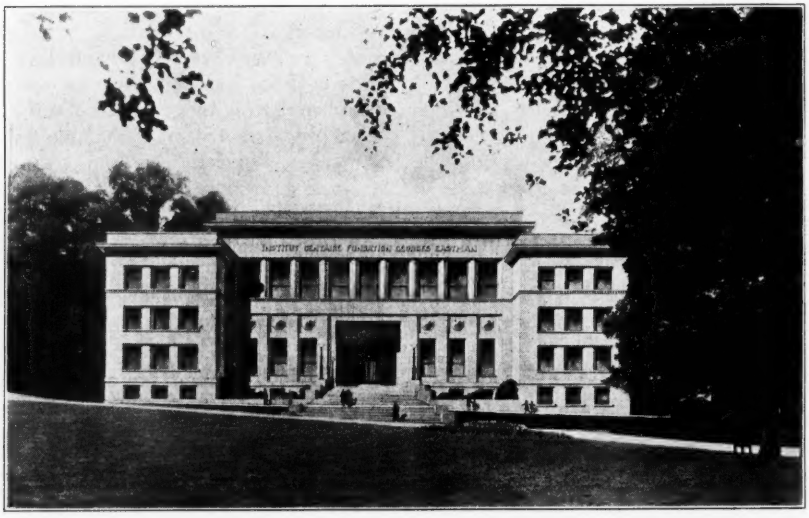
During recent years, it has been realized that pregnancy imposes a special strain on the teeth of the expectant mother, and that in her interest and that of her unborn child, she should be provided with adequate dental attention. Provision of this sort is made in most antenatal clinics, but I wonder how many of the six to seven hundred thousand mothers who had children last year received proper dental attention during pregnancy and how many appreciated the necessity for such treatment.

Thus, we see that, from conception to the grave, dentally speaking, His Majesty's subjects are in rather a parlous condition. No doubt, you will be asking yourselves what remedy I have to propose. The answer is simple: We must make the public interested in their teeth. To do this, we want more and better publicity for the advantages of dentistry. First, we want a new type of dental article for the press, a type of article that will attack the public from a new angle—something bright and arresting—something that will explain in popular

language the advantages of dentistry, the hygienic and esthetic hazards of neglecting one's teeth, and the effect of food on the teeth—vitamin D, roughage and the rest. Editors cannot be expected to discover these articles. They must be submitted by persons who have been coached by experts, and who expect to be paid for their labors. Voluntary articles are not regarded with much favor, particularly if they smell of propaganda.

Secondly, more use should be made of the periodicals, particularly those intended for women.

Thirdly, each borough should have its "Tooth Day" every year. On this occasion, a public meeting should be held at which speeches are made in favor of better attention to the teeth. The aid of the local newspapers should be secured, special addresses should be delivered to the school children and employers of labor should be asked to provide facilities for addresses to their workers. Here I may say in parenthesis that it is refreshing to note that some big employers are already impressed with the importance of good teeth and that they have taken steps to provide their workers with facilities for dental attention. Generally speaking, for one day, at least, in the year, the whole community should be made to think and talk about their teeth. I believe that the rotary clubs throughout the country might be induced to father and organize this part of the movement, but it would be necessary to convince them of its importance.



Institut Dentaire Fondation Georges Eastman, Brussels

Of course, it is essential to continue to urge the local authorities to make their school and antenatal services more efficient and the approved societies to provide their members with better dental attention. But, above all, it is vital for dental reformers to create what I may call a "tooth sense" in the public mind. Until this is done, we cannot hope for real improvement in the nation's teeth.

I understand that the dental board carries on a certain amount of useful propaganda work, but hitherto there has been no attempt to make a rousing national appeal. Believing as I do that care of the teeth is the most practical and important part of preventive medicine, I feel that the time has come when more active steps should be taken to arouse public interest.

For my part, being in the newspaper and periodical business, I shall be glad to render all assistance in my power. It rests, however, with the dental profession to guide the nation in dental matters. Every dentist and every dental student should be an active missionary for dental reform.

In conclusion, may I suggest that the dentists in every district form an association, not only to discuss dental technic, but also to discuss methods for arousing public interest in dentistry in their particular neighborhood.

PROGRESS REPORT ON RESEARCH ON DENTAL MATERIALS (1932)*

By GEORGE C. PAFFENBARGER,† D.D.S., and WILLIAM T. SWEENEY,† A.B.,
Washington, D. C.

WORK COMPLETED

THE National Bureau of Standards and the American Dental Association have now completed four years of cooperative research on the physical properties of dental materials. The work to date of this cooperative research on amalgams, waxes, investments and golds was in a large measure an amplification and continuation of the work of Souder and Coleman.[1] The work at present is so planned as to include eventually practically all dental materials whose physical properties are of importance to the dentist.

Experience with the cooperating committee of dentists clearly demonstrated that there were in 1930 no electric furnaces on the market which embodied the features required for their work. Consequently, a furnace, shown in the accompanying illustration, was designed by the laboratory workers here in cooperation with a reputable furnace manufacturer which it was felt would meet the needs of the committee. This furnace was made available for experimental

*A report to the Research Commission of the American Dental Association.

*Publication authorized by the Executive Board of the Research Commission of the American Dental Association.

*Read before the Section on Partial Denture Prosthesis at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

†Research Associate for the American Dental Association at the National Bureau of Standards.

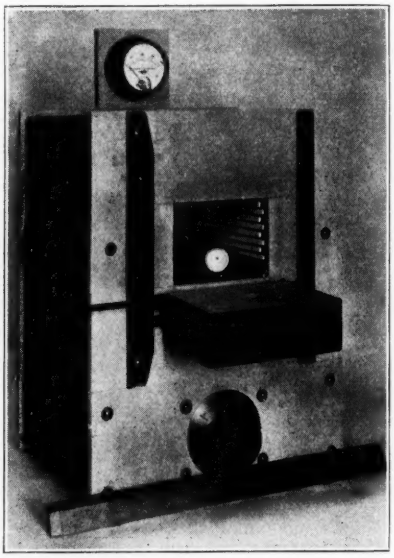
1. See bibliography of publications giving data on dental research conducted at the National Bureau of Standards, J.A.D.A., 19:405-406 (March) 1932.

purposes to members of the cooperating committee and any other interested parties at practically the wholesale price, for a limited time. Forty-eight of these furnaces were sold under this agreement and in addition to these, twelve were purchased by the Dental Corps of the U. S. Army. No member of the dental laboratory staff of the Bureau of Standards or of the Research Commission of the American Dental Association had or now has any interest in the marketing or the production of the furnace other than a desire to provide suitable and reliable equipment of this type to the profession. After the furnace passed the experimental stage, this laboratory gave it no further consideration. Other furnaces of somewhat similar design are now on the market.

The work in 1932 was devoted largely to the study of wrought gold wire alloys used in orthodontia and in prosthesis. A report of this work embodying data on the physical properties of the wires, the effect of various heat treatments on these properties and a tentative specification was presented at the 1932 meeting of the American Dental Association.[2]

The physical properties, advantages and use of the material cristobalite in dental investments were presented in a previous paper.[3] Cristobalite is found in nature in only small quantities and is not commercially available in a pure state.

Its production in large quantities is expensive because of the extremely high temperatures necessary to convert quartz or other forms of silica into cristobalite. In addition, it was necessary to do considerable experimental work relative to its synthesis in a comparatively pure state. A second paper, "Cristobalite for Dental Investments,"[4] giving results of numerous experiments relative to its production, together with a third report from the Bureau giving some additional observations on the casting of gold, were also presented at the 1932 meeting.



Electric furnace designed for use in experimental work on dental materials.

WORK PROPOSED AND IN PROGRESS

Eighteen brands of zinc "oxyphosphate" cements have been purchased and are being analyzed and studied. A preliminary report of these studies should be ready for the 1933 (Chicago) meet-

2. Paffenbarger, G. C.; Sweeney, W. T., and Isaacs, Aaron: Wrought Gold Wires: Physical Properties and a Specification, J.A.D.A., 19:2061 (Dec.) 1932.

3. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Dental Inlay Casting Investments: Physical Properties and a Specification, J.A.D.A., 17:2266 (Dec.) 1930.

4. Sweeney, W. T.: J.A.D.A., 20:108 (Jan.) 1933.

ing of the American Dental Association. This work is in a new field and progress may be slower than on the materials previously studied. Standard methods for accurate chemical analysis of these cements, together with a suitable outline for physical tests, had to be developed.

Forty amalgams which are guaranteed by their manufacturers as complying with the requirements of either the American Dental Association's Specification No. 1 or the Federal Specification No. U.A. 451 (formerly No. 356) have been purchased. They are now being tested to ascertain whether they will meet the requirements as guaranteed. Other guaranteed dental products may be tested in a similar manner.

PERSONNEL

Reorganization of the American Dental Association's research staff at the National Bureau of Standards, following the resignation of N. O. Taylor, Nov. 1, 1931, was completed Jan. 1, 1932. Since then, the following men have been on full or part time assignment to dental research:

For the Bureau: Wilmer Souder, Aaron Isaacs and Norment D. Hawkins, 3d; for the Association: George C. Paffenbarger and William T. Sweeney.

HIGH STANDARDS FOR DENTAL MATERIALS

Specifications and standards are being widely used as an intelligent basis for the purchase of materials of all kinds. In dentistry, when certain materials are used either directly or indirectly in public health activities, the need for standards is imperative.

This need has been recognized by the U. S. Government departments, as in the past the cost of replacement of defective material was borne by the purchaser. These specifications are now used, and defective materials, when offered, are promptly rejected. Satisfactory materials to replace them must be furnished at the expense of the manufacturer. The American Dental Association also recognized this need when it continued the research fellowship at the National Bureau of Standards in 1928. Therefore, a large portion of this work was undertaken with the primary view of establishing such standards as a basis for purchase by the dentist. The following tentative specifications have been adopted by the Research Commission and the House of Delegates of the American Dental Association:

No. 1. Dental amalgam alloys
No. 2. Dental inlay casting investments
No. 3. Dental impression compounds
No. 4. Dental inlay waxes
No. 5. Inlay casting golds
  (*a*) Soft
  (*b*) Medium
  (*c*) Hard
No. 6 Dental mercury
No. 7. Wrought gold wire alloys.

These specifications are subject to revision as additional knowledge becomes available. Discussions and criticisms when backed by reliable data will be reviewed and considered by this laboratory and the Research Commission of the American Dental Association. If it is found that the suggested changes will strengthen the specifications, they will be incorporated. Specifications Nos. 1 and 4 are now being revised. The Association is interested in having these specifications or standards for dental materials as high as practicable, since inferior materials are still being sold to the profession by misleading advertising and sales practice.

In general, conditions have steadily improved, and there are now many reputable manufacturers whose dental products are guaranteed by them to meet the specifications, and do in fact meet

them. This distinct advance over conditions of even a few years ago is a most hopeful indication of what may reasonably be expected in the future.

If these high standards are to be effective, the dentist should cooperate by purchasing from manufacturers who are testing their products and guaranteeing compliance with these standards.

The dentist should also adhere to the manufacturer's technic for the particular product that he is using. The specifications state that an adequate description of technic must accompany the products which are guaranteed to comply with the specification. This is necessary because the properties of the materials can be profoundly changed by variation in technics.

SPECIFICATION AS REPRESENTING SATISFACTORY REQUIREMENTS

Statements have been made that American Dental Association Specification No. 1 for dental amalgam alloys is inefficient in that its requirements are the minimum and that neither the Bureau of Standards, where it was designed, nor the American Dental Association, which adopted it, intended it to be a high standard for amalgam alloys.

While it is true that the American Dental Association specifications represent the minimum requirements in each case, this fact should not be interpreted as indicating that the specifications will admit inferior or low grade material. It is a well known fact that the American Dental Association's specification for dental amalgam alloy is so high that only the superior alloys can meet the requirements specified. The Association is willing to make the requirements still more rigid if it can be shown that higher requirements are necessary and can be met.

The American Dental Association specification for dental amalgam alloys has been in use since 1929. It is almost the same as Federal Specification UA 451, which has been used since 1926. The data for this specification were presented to the profession in 1920.[5] Thus, the specification has given six years of satisfactory service.

PRODUCTS NOT "APPROVED"

Several publications giving data on dental research conducted at the National Bureau of Standards have contained the trade names of the materials tested. Data from some of these have been utilized in advertisements and in sales promotion with the seeming intent of implying that the Bureau of Standards or the Research Commission of the American Dental Association or both guarantee or approve certain materials. Such advertisements are false and misleading. Neither the Bureau nor the Association guarantees or approves dental products which were investigated at

ADDITIONS TO LIST OF CERTIFIED PRODUCTS

Trade Name	Manufacturer	If not tested in manufacturer's plant data were obtained by
	AMALGAM	
Twentieth Century	L. D. Caulk Co.	
	INLAY WAX	
Kerr's Hard	Detroit Dental Mfg. Co.	
Peck's Purple	A. E. Peck Mfg. Co.	John M. Adams
Peck's Blue	A. E. Peck Mfg. Co.	John M. Adams

5. Souder, Wilmer and Peters, C. G.: An Investigation of the Physical Properties of Dental Materials, Technologic Paper of the Bureau of Standards No. 157; sold only by the Superintendent of Documents, Washington. D. C. (10 cents).

the Bureau of Standards. The following quotation,[6] which was inserted in the reports to eliminate such misrepresentations, indicates the attitude of the Bureau and the Association in regard to guarantees of dental products:

> Obviously, this list must not be regarded as proof that all packages of the various brands, sold during the first half of the year 1930, met the requirements. Nor must it be regarded as proof that packages of these brands purchased subsequently will meet the requirements.
>
> Guarantees of these conditions must be supplied by the individual manufacturers.

That the guarantee is made by the manufacturer, and that he is responsible for its fulfilment should be indicated beyond question of a doubt by any statement or guarantee employed in advertising. When a reputable manufacturer says, in effect, "We the —— Co. guarantee that our product ———— is in accordance with American Dental Association Specification No. ——," there can be no doubt as to responsibility for the guarantee. Such advertising should be encouraged.

On the other hand, advertisements which are indefinite as to responsibility, or which imply approval or guarantee by anyone other than the manufacturer, should be looked on with suspicion and ignored by the profession.

CERTIFICATION PLAN

A certification plan was adopted whereby the Research Commission lists materials that the manufacturers are willing to guarantee as complying with the specifications listed earlier in this paper. The first list of this type was published in 1930.[7] Subsequent reviews of these certifications and the actual properties of several of the certified products indicated that several of these certificates had no basis in fact. Following this, a second list[8] of certified products was published. The products in this list were not accepted for certification unless a sufficient number of data were presented to show that the products met the requirements.

Additional certifications received since the publication of the foregoing list are given in the accompanying table.

The Research Commission has directed its research associates to purchase in the open market materials that are guaranteed by their makers to meet the various American Dental Association specifications and to test these materials for compliance with these specifications. Thus, by these check tests, the profession will be further protected against inferior products. Likewise, the manufacturer who is actually producing specification materials and has adequate testing facilities will also be protected against unfair trade practice.

It is felt that these safeguards will protect the dentist in the purchase of satisfactory materials. It is then his duty to employ them correctly.

6. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Inlay Casting Investments, J.A.D.A., 17:2285 (Dec.) 1930.

7. Taylor, N. O.: Specification for Dental Amalgam Alloys, J.A.D.A., 17:120 (Jan.) 1930.

8. Taylor, N. O., and Paffenbarger, G. C.: Progress Report on Research on Dental Materials, J.A.D.A., 19:407 (March) 1932.

CHILD MANAGEMENT*

By C. WILFORD WILSON, D.D.S., Detroit, Mich.

IT IS my aim to present the subject "Child Management" from the standpoint of the general practitioner. A few procedures that have been found successful in the majority of cases will be suggested in the belief that something of proven value is of practical application. With a little patience and perseverance, almost any child can be handled successfully; i. e., to its own satisfaction and to the financial gain of the dentist.

Our reports are beginning to show that, at the present time, the majority of people have the required dental work done for their children and delay work that is necessary in their own mouths. This has been verified in my own practice, with eight cases on record since the first of the year wherein the parents refused to have their own work done because of economic conditions, yet insisted on having the necessary dental work of their children completed.

If the child is properly handled and instructed on his first visit to the dentist, he will not look forward to future work with the fear and dread that is prevalent in the minds of so many adults of today. We all know that the adult of today on whom it is difficult to work and who is fearful of a dentist will, if questioned and his past history traced, admit that he has at some time been ill-treated or deceived while receiving dental services. The paramount issue, and the thing that must constantly be borne in mind in children's work, is absolute truthfulness and sincerity. There is nothing that we can do more reprehensible than to deceive or surprise the younger patients.

May I say once more that this paper is given from the standpoint of the general practitioner. I am not a pedodontist, and anything I give here is of such nature that it can be applied to any dental practice.

The ideas and suggestions set forth in this paper are the consensus of opinion of our group, and bear in addition my own individual endorsement—I practice faithfully and advantageously everything listed herein.

APPOINTMENTS

In the matter of appointments, the time schedule is most strictly adhered to. If anything, we should be more strict than with adult patients. The average length of the appointments should vary from twenty-five to forty minutes, the first one being a trifle shorter than the ones following. It is apparently true that the work accomplished in this period of time is of most definite value to both the operator and the patient, and, at the same time, is not overtiring to either.

As to frequency of appointments, much depends on the temperament of the child, although the twice a week schedule seems

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

to be logical. Some children may require longer rest periods than others and the desires of the parent must be considered as well.

Casual Appointment.—If the child is brought in without an appointment, we try to avoid doing anything for him unless we have the time to give him a complete examination or some beneficial treatment, i. e., either prophylactic care, the sealing of a sedative in an aching tooth, or the insertion of a small filling that can be made quickly and painlessly.

Emergency Appointment.—An emergency appointment for a strange child takes all the tact and ability that we possess. These patients are the most difficult to handle. In my practice, if a case of this type comes in, I make it a point to take the time to handle that child correctly, even if the following appointments have to overlap. A child in the frame of mind associated with emergency care is deserving of this consideration, and it will make of him a better patient for the future. Most patients are willing to wait if one has an emergency patient and they are so informed.

Prearranged Appointment. — If the parent calls and makes an appointment, which we encourage as much as possible, our main object is to get the child's first name and to reserve thirty minutes for him. Any less time than this is an injustice to the parent for going to the trouble of bringing the child in; an injustice to the child because he will have to be hurried through, and a financial loss to the operator, as it is impossible to accomplish anything of material value in less than that time.

FIRST APPOINTMENT

Time Allotted.—It has been found that the first appointment should be a trifle shorter than subsequent appointments so that the child will not become too tired and restless. I make it a point never to keep a child over thirty minutes the first time, and if he gets too restless and tired, perhaps not that long. The thing that must be avoided at this time is giving the child any impression that will antagonize him so that he will not desire to return. At the same time, it is necessary that enough be accomplished to be of benefit to all. The patient must obtain some actual benefit and service; the operator must render some service which will enable him to exact a fee, and the parent must be compensated for his or her time and effort.

Establishing Confidence. — A portion of this first appointment must be given over to gaining the child's confidence. This is done by showing him every step in the operative procedure, even to the smallest detail; showing him how each instrument works and the reaction he will get from their use. Also, he must have some time to form his own opinion of us and our attitude toward him. We control this to a large extent, and on this factor —his own opinion—depends our success or failure. The patient and the mother both will want that great big cavity fixed first, but if we are wise, we will attempt nothing for that tooth other than a sedative treatment. We should make it a point to put in and finish some small filling which can be done painlessly so that the child will have something to show. It makes him proud of himself and gives him confidence in us.

Promptness.—As I have said before, we are more careful in regard to being ready when we have an appointment with a child than we are with adults. A child should never be kept waiting in the reception room if this can be avoided. I make it a point to have the door open and be waiting when he arrives. My greeting is directed to him and he is called

by his first name. This is bound to make an impression, and it will help to do away with formality. I do not believe that the practice of calling a child by a pet name, such as "honey," has any place in the present day office. That privilege should be reserved to the parents. Do any of us get any great satisfaction out of hearing a stranger call our children names of that type?

Acquiring Information.—As much information as possible, such as name, age and address, should be obtained directly from the child. Thus he is to realize that he is the one who has the appointment and is the only one that counts as far as you are concerned. If anything, ignore the parent just a little more than you think you should in order to make the child feel his importance. If he is not old enough to give the desired information, ask him anyway and the parent will help you out, but be sure to concentrate on that child.

Assistant.—All that I have said regarding the child's arrival has been exactly what I do myself, because, as I have stated, I do not have an assistant. In case an assistant is employed, it should be her duty to greet the child and acquire the information. The dentist should be waiting at the chair as she brings the child in and should call him by his given name in a friendly, cordial voice. One should very closely instruct an assistant in her attitude toward children because they will get their first opinion of the dentist through her.

PROCEDURE

Operating Room.—An operating stool is a most necessary adjunct in any office where children's work is done. It is much easier to do the same work if one is sitting down, and the eyes are on a level with those of the patient, rather than towering over him so that he has to look up. If a stool is not convenient, it is well to let the arm of the chair down and sit on that. For some reason, this gesture seems to do away with formality, and the patient does not seem to feel so helpless.

General History.—A few questions are asked as to the home life of the patient, his grade in school, the names of playmates, etc. Do not be afraid of spending a little time in getting acquainted and attempting to secure his confidence, as well as in studying his temperament. A few minutes spent this way will save more time later on.

Dental History. — After seating the patient, we inquire as to the dental difficulties, and if there are any, have him point out the offending tooth with his own finger. Then we always inquire as to whether he has had any past dental work done and note his attitude toward it.

Education of Parent. — The dentist should point out clearly whatever condition is found in the mouth, showing the mother with an explorer how pit and fissure cavities progress to more serious trouble. Any exfoliating or permanent teeth should also be pointed out. Here is an opportunity to give a lesson in oral hygiene and the development of teeth.

CLASSIFICATION

By this time, we should have a rather thorough understanding of the patient and he should have a fairly good opinion of us. As a matter of convenience, and with no scientific analysis in mind, we have adopted the following classifications, covering virtually every type of child, each one of which must be differently treated.

1. *The Normal or Bold.*—This type needs little consideration. The patient will usually walk in to the chair and cause no trouble at all. He talks readily and it is not necessary to go into much detail with him. I usually treat him as

I would an adult, only being careful to do nothing that will diminish his confidence. Again, I am absolutely honest with him and let him know what to expect and when to expect it. The presence or absence of the parent in the operating room makes no difference with this type of child. Personally, I would rather have the mother or father present for educational purposes.

2. *The Bashful or Timid.*—This type usually clings to mother's dress and will not leave her. He is afraid of strangers and does not become easily acquainted. I let the mother take him in and seat him, although I first try to see if I can get him to take my hand and let the mother follow. If he is handled correctly up to this point, I am usually successful. The mother must be kept very close to this patient, and I usually ask her to stand at the left side of the chair. She frequently holds the child's hand, to which I have no objection, until I see that he is gaining confidence. Eventually, I want her to be seated behind the chair, where she can see all that is going on and converse with the child if she desires, but the child cannot see her. We waste less time in nearly all cases if we make it a practice to have the third party in the operating room in this position.

The dentist must be on the alert not to offend or deceive this type of patient and to show him everything to the minutest detail. Truthfulness and sympathy are, I believe, the main points to remember with reference to this type of patient.

3. *The Hysterical Type.*—This is the type of child that is usually crying as he comes into the room and will not let go of the mother's hand nor listen to reason. As a rule, this type of patient cooperates better when alone; although, in some cases, we may find that the mother insists on being present; in which case, it is well to grant her wish. Then we find that it is necessary to lift the child bodily and seat him in the chair with the mother on the left where he can see her. It is seldom that anything is accomplished by efforts at explaining; the mother's confidence must be established, the dentist showing her what is to be done and why, then proceeding to do it. Sympathetically but firmly, we insist on the patient doing as we say and when, but the parent is the one that we must endeavor to please with this type of child. The chances are that the first appointment will result in a continual flood of tears, the entire situation proving most difficult to cope with. The tears must be ignored and some definite restoration completed with a firm, sympathetic hand. There will be much less trouble at the next appointment. The presence or absence of the parent depends on her own reaction to the tears of the patient.

4. *Rebellious Type.*—With this type, the parent tells how many dentists have tried to work for the child and have given up. The parents can do nothing with the child, nor can anyone else. The child knows it and stands there, staring defiance. He may get in the chair and he may not. I insist that the parent in types of this kind stay in the reception room, and I quietly lock the door to prevent the parent from coming in. When the child is placed in the chair, he will pay absolutely no attention to our requests, and will defy every move we make. Trays should be put out of the way so he can kick all that he desires. With a towel in the left hand, and standing by the patient's side, we take both his hands in the right hand and hold them firmly between his legs. This will prevent his slipping out of the

chair. At the same time we slip the left hand around his neck and cover his mouth with the towel, keeping the thumb and forefinger free. This will muffle his crying and make it slightly difficult for him to breathe. Holding him in this position, we tell him in a calm, quiet voice that as soon as he is quiet and good, we will release him. In the majority of cases, he will do so within a few seconds and we can then proceed. The operator must be in readiness to repeat this procedure two or three times if necessary to get him to keep his promise.

Once in a great while, a child, in spite of the fact that we have him in this position, will not give in an inch, but will continue to yell and kick. If he does so, the left hand is used to close his nostrils with thumb and forefinger, until he really needs air, as indicated by his color. All the time, the operator continues talking quietly. It may be necessary to repeat this once or twice, but with forceful and prolonged repetition, we can eventually break his iron will. In the majority of cases, just putting the hand over his mouth will be sufficient, but occasionally it is necessary to go to the extreme.

This may seem rather extreme, and it is, but it is an extreme case, and calls for such treatment. As far as I know, it is the only way such cases can be successfully handled. A balky horse calls for a beating, but when we conquer him, he is probably the best horse we can get. We cannot strike or beat a child, yet he must be shown that we are in authority, and if it is necessary to use this method, we have an ideal patient at the next appointment, if we insist on finishing some piece of work for him that day.

The points to remember with this type are: hold the patient's nose until he really needs a little air—it will frighten, but not hurt him; lock the door so that no one can come in; complete some work at that sitting, and finally tell the parent what has been done and why it was done. It is possible to control a child of this type by this method, and the parent becomes our ardent supporter.

It goes without saying, that, in cases of this type, the parent must be *locked* out. Otherwise, she may rush in at the wrong time and spoil our plans. I have never heard of parents complaining of this procedure after it is explained what was done and why it was done. They are only too pleased to find someone who can manage the child after the repeated failures of the past.

COOPERATION

In the matter of cooperation, as shown above, some children need a much firmer hand than others. Some will listen to reason; while with others, a dominating attitude has to be maintained. Children should at all times be treated as adults and our equal socially. Be friendly, sympathetic and understanding, at the same time holding the child at arm's length and keeping him under control.

RELAXATION

One of the factors in getting the child to assist the dentist is to get him to relax. It has been my experience that although the patient is told repeatedly to relax, the minute work is started the muscles will tighten and the noise or the slightest slip of the drill is painful. For this reason, I absolutely insist that the patient keep the eyes open and the word "relax" is not mentioned. If you wear glasses, call attention to the fact that the patient can see his reflection in the lens; speak of different pictures or instruments he can see from where he is. In some pedodontic offices, a practice is made of throwing moving pictures on

the ceiling to attract the attention. There are many methods that can be used, but the operator should insist that the eyes do not close at all, not even during extraction.

FINGER METHOD

Occasionally, a patient will not rebel to any great extent, but will not open the mouth. In this case, the operator should not be alarmed or too severe. If the forefinger is thrust sharply and with considerable pressure back of the last molar in the conductive area, the mouth will open. This is successful even when the patient is under the influence of a general anesthetic.

HAND SIGNAL AND COUNTING

There are two methods that I have found to be successful in getting a child to keep his mouth open long enough to really accomplish something. I have him keep his hands in his lap and raise the left one as soon as he wants me to stop. I do not let him touch my hand, for one patient who did so had his lip badly cut. The other way to get the patient to cooperate is to have him count, five the first time, ten the second, and it is surprising how quickly he will concentrate on seeing if he can count to forty or fifty. We should always remember to stop when his hand goes up as an indication that he has finished counting. In this manner, a little game can be worked up, and if you wish to see how fast a child can really count, try it yourself.

INSTRUMENTATION

Each and every instrument should be shown to the child before it is inserted in the mouth. I call them by name and show exactly how they work. The common practice of hiding instruments is particularly erroneous. We would much rather hide them from the parent, which we do attempt to do, than from the child. This act alone will breed suspicion in his mind, and we have lost our greatest asset, confidence, before we start. The parent is the one who has the real fear of the instruments and has instilled that thought in the child.

I always use the mirror first, showing the patient how it will reflect and magnify his finger nail, and how the explorer and excavator are sharp and will find the soft spots in the tooth. They will not hurt his finger nail and yet will easily go through his sleeve. I run the drill on my own thumb nail and let him see it cut the small shavings off, then actually do it on his own thumb. I tell him that it does exactly the same to his tooth, only it will make a noise and may get hot, and if it does, he is to raise his left hand. I always make all the noise on the front tooth that I can at first, and then drop back to a posterior and do the same thing. Now I start on the cavity. The first time, I make all the noise that I can, only stopping when the hand goes up. The second time, I let it get a little warm as I said it might, but do not hurt him or give him any sense of pain. In this way, the child will have been shown that I knew what would happen. He will believe me thereafter. Yet that word "hurt" that he has heard so much about has not even been mentioned. Now I tell him "this will hurt" and then be sure it does, and when his hand goes up, stop. Again I have proved that I know "what it is all about" and from then on, I find that by telling the patient what is going to happen, when it will occur and all about it, I can do as much for him as for most adults. There are some men who never allow the word "hurt" to be spoken in the office. They use expressions like "feel it," and "bother." I believe better results are to be had by say-

ing frankly, "It will hurt." I am particularly careful about mentioning it ahead of time.

OPERATIVE SUGGESTIONS

Explanation of Decay.—I explain to the child that decay in a tooth is the same as a rotten spot in a banana or apple: "Mother cuts that out before you eat it and I have to do the same to the tooth before I fill it." In cavity preparation work, very often we let the child hold the large hand mirror if it does not interfere with our work too much so that he can see exactly what is going on. Above all, we show both parent and child the tooth with the black spot on it, the cavity after it is prepared and the completed filling after it is polished. I want them both to appreciate what I am doing and, in a great many cases, I make it a definite point to have the mother actually hold the cotton rolls for me. You will be surprised at the comments they make, and they will come to appreciate really good dentistry. If the child is old enough, we have him hold the cotton rolls in the mother's stead.

I always save the tooth in a case of extraction, clean it off and try to get the patient to take it home and show his friends. It fosters his pride.

FINAL APPOINTMENT

Gift.—In some offices, a practice is made of giving each child an inexpensive toothbrush and a small tube of paste for his very own. This has a definite psychologic reaction on the younger minds and is a very valuable practice.

Bribe.—We do not believe it is ever necessary to coax or bribe a child. This we absolutely disapprove of. If any reward is to be given, it should be given after the work is all finished and not after the individual appointment. It may then be a good point to give him some trifle, not as a reward for having his teeth fixed, but as an appreciation of his good behavior and your friendship for him.

Use of Cards.—A practice that appeals to me a great deal is that of sending out individual birthday or Christmas cards. This has been worked in many offices to excellent advantage. The only reason I have not adopted the practice is that it involves much detail work for one man.

QUESTIONS

In closing, I should like to mention a few of the questions that are most frequently asked of one doing children's work.

We do not approve of playrooms or toys for our patients because of the danger of transmitting disease from one to the other. I would not want my child playing with the toys that many other children had handled, and perhaps put into the mouth, and I am sure that you would not either. We do make it a point to have appropriate magazines at hand in case it is absolutely necessary to have patients wait, although we are very particular not to let these periodicals get old and dirty.

Certain people will ask if we strap a child in the chair and possibly go so far as to even strike him. I have never seen any straps for that purpose in an office and do not consider them at all necessary. As for striking a child, there are many times when that seems the thing he needs most, but nevertheless it should never be done. That is the parent's privilege. The most extreme method used is the towel method, which is very successful as a substitute, and one is not liable as he would be if he ever struck a child.

The question of having the parent in or out of the room, I feel has been covered. The temperament of the child and mother should govern that point.

Some people are of the opinion that we spend much time in playing and telling

stories. As far as my own practice is concerned, and I have both adults and children as patients, it has been proved to my own satisfaction that the expenditure of just a few minutes of the first appointment in studying the child and classifying him and being honest, sympathetic and understanding to the finest detail, makes play unnecessary, and less time is wasted than with the adult, with whose aid questions of the weather, public welfare and economic conditions have to be solved while the operator is attempting to do a little work.

We hurt children when it cannot possibly be avoided, but we always tell them beforehand, and it has been my experience that if this is done and we have their confidence, they will endure as much pain as the adult. At the same time, they will come into the office at the next appointment in a much more receptive mood and consider the dentist as one of their best friends.

STUDIES OF THE CAUSE AND NATURE OF DENTAL CARIES*

By JOHN J. ENRIGHT, Ph.D., and H. E. FRIESELL, D.D.S., Sc.D., Pittsburgh, Pa.

THE etiologic and preventive aspects of dental caries are the major problems that confront the dental profession today. In the past, the wide prevalence of dental caries, with its consequent causation of pain, of interference with proper mastication and digestion and of loss of esthetic values, has convinced dentists generally of the importance of the unsolved problems connected with the disease. In recent years, two new developments make more urgent than ever the need for intensive research to solve these problems. These two developments have been, first, the demonstration that dental caries is often an important link in a chain of more serious illnesses and, secondly, a growing disagreement with generally accepted views on the etiology and prevention of tooth decay.

During the past decade, there has been an increasingly large group of dentists who believe that local environmental conditions play no part or only a minor rôle in the causation of tooth decay. This school of thought maintains that any program of prophylaxis based on oral hygiene is bound to be of slight value and that our only hope of combating caries successfully is through proper diet.

If the belief or claims of this school of thought are correct, there should be considerable concern on the part of dental authorities who are responsible for the widespread oral hygiene movement of federal, state and municipal agencies. Furthermore, our teachings in operative dentistry, especially as far as the extending of cavity outlines to relatively immune areas in order to prevent the recurrence of decay around fillings is con-

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cerned, must necessarily be changed radically.

Ever since the classic researches of Miller more than fifty years ago, which established the bacterial and local environmental conditions as the primary cause of dental caries, conclusions which were substantiated and further amplified by the investigations of G. V. Black and J. Leon Williams, a large majority of dental teachers and practitioners have accepted these findings as basic facts in the pathology of dental caries and upon them have based our whole program of oral hygiene and operative dentistry.

At present, we have two schools of thought on this important subject which might be classified as (*a*) the local environmental group and (*b*) the nutritional group.

Fig. 1.—Insoluble area that resulted when entire tooth was immersed in normal lactic acid for twelve hours.

The clearly pressing need for knowledge relative to the pertinent factors in the cause and prevention of dental caries brought about the foundation of a multiple fellowship at Mellon Institute in 1923. The studies of this fellowship have been continuous for the past nine years, during which the cooperation of many specialists in the University of Pittsburgh School of Dentistry has maintained an enthusiastic and broad outlook on the problems under investigation. During the first two years, one of us (H. E. F.) and Vogt made an extensive study of the relation of p_H, the calcium and phosphorus content of saliva, to the occurrence of dental caries, and also a study of the effects of acids on enamel.[1] The results of these investigations led to the decision that no correct solution of such a complex problem as the cause and nature of dental caries would be possible without the combined resources of modern scientific knowledge in the fields of dentistry, histology, chemistry, bacteriology and nutrition. The following report deals particularly with the studies of the last six years.

The local environmental school (the older of the two) maintains that caries is caused by mouth organisms that produce lactic acid in fermenting carbohydrate food débris and that the acid decalcifies the tooth enamel. This decalcification occurs at "retention centers": pits and fissures and proximal and gingival areas at the gum line. Certain gaps have been pointed out in this theory from time to time and, as a consequence, the last decade has brought into prominence the school of thought that maintains the primary importance of proper diet in the control of caries.

Among the gaps that have been pointed out from time to time in the view that dental caries is caused by the fermenta-

1. Friesell, H. E., and Vogt, C. C.: Report Concerning Etiology of Dental Caries, J.A.D.A., 13:748 (June) 1926.

tion of food débris on the teeth, the following may be enumerated briefly:

1. The carious areas produced artificially by acid have not stimulated natural caries in certain particulars; namely, invasion of the enamel to the dentino-enamel junction with surface continuity still intact along with typical flamelike spread of the process at the dentino-enamel junction.

2. There has been no sound explanation of the cessation that sometimes occurs in carious processes for indefinite periods.

STATUS OF INFORMATION WITHIN THE NUTRITIONAL SCHOOL

As time will not permit a detailed historical report of the investigations of a nutritional nature in this presentation, we merely mention that Mellanby and Howe have made the most extensive contributions in this field and that the works of Hanke and Hawkins have been quoted quite often.

Fig. 2.—Acid insoluble wall around cavity. This wall took above indicated form when entire tooth was immersed in 5 normal nitric acid for ten minutes.

Fig. 3.—Acid insoluble wall around cavity. This wall took above indicated form when entire tooth was immersed in 5 normal nitric acid for ten minutes.

The information that has been accumulated on the relation of diet to dental caries is convincing testimony of the fact that proper diet is at least an important predisposing factor in tooth decay. It is apparent, however, that our knowledge on this subject is still quite meager and debatable. Howe and Hanke emphasize the importance of vitamin C, and disagree with Mellanby, who holds that vitamin D is the important factor; while Hawkins and others lay particular stress on the importance of diets that give a high alkaline ash and high calcium level in the saliva. More recently, two other contentions have been emphasized, with Hoppert finding that the physical character of the diet as regards its retention by the teeth is the important factor; while Klein and McCollum stress the importance of the phosphorus level in the diet and saliva.

Though much constructive knowledge of the cause and nature of dental caries has come from these nutritional studies, much confusion has arisen in the minds of dentists from the interpretations of certain investigators, who, in attempting to emphasize the value of nutritional factors, seem to discount the importance of the effect of the local acids of fermentation in causing decay of the enamel. It should be noted that Bunting, Drain, Bödecker and certain others who have reported evidence that has been used to strengthen the claims of the nutritional school have not abandoned the position that attributes direct active importance to local environmental factors.

It appears to us that the most liberal interpretation justified from the progress of studies of the relation of nutrition to

dental caries is as follows: (*a*) diets rich in vitamins A, C and D and an alkaline ash utilized during the developmental period of teeth will produce teeth less liable to decay; (*b*) a continuation of a similar diet during the posteruptive stage of teeth will assure a saliva with some protective power against caries, and (*c*) deficient diet is important only as a predisposing cause of caries of the enamel.

At this point, it seems pertinent to call attention to some of the outstanding clinical features of dental caries, which, strangely enough, appear to have been entirely ignored by several of the workers in this field of research.

Fig. 4.—Acid insoluble proximal caries of enamel. This prominence resulted when entire tooth was immersed in 5 normal nitric acid for ten minutes.

Fig. 5.—Acid insoluble proximal caries of enamel. This prominence resulted when entire tooth was immersed in 5 normal nitric acid for ten minutes.

SOME CLINICAL ASPECTS OF DENTAL CARIES

Dental caries is a chemical dissolution of the calcium salts of the enamel and dentin of the teeth. When caries attacks the enamel, the entire carious area is dissolved, because there is so little organic matter in it that it will not maintain its form, and a cavity results. When caries reaches the dentin it dissolves the calcium salts, but there is sufficient matrix of organic material in dentin that while it becomes softened by loss of the calcific material, it still retains its bulk and form for some time. This organic matrix of the dentin is eventually decomposed and dissolved and a cavity occurs in the dentin also.

Caries first appears on the enamel surface as an area of unnatural opaqueness caused by interference with the refraction of light rays due to the irregular dissolving of the calcium salts of the enamel. The first appearance of caries in dentin is a softening of that tissue. Caries always begins on the surface of the tooth, never in the interior. The enamel must be decalcified before the dentin is reached; or, in those cases in which dentin *seems* to be decaying much more extensively than the enamel surface, the causative agents have reached the dentin through defects or faults in deep pits or fissures which extend through the body of the enamel. These defects occur during the formation of the enamel, leaving microscopic openings from the mouth to the dentin where the enamel lobes have failed to join.

When caries attacks a tooth, it does not affect the tooth uniformly all over its exposed surface, but begins at points so definite on each anatomic surface of the tooth that an experienced operator can readily predict where decay will begin on a given surface and to what limits it will extend on that surface. Some areas of tooth surface are practically never attacked by this disease.

There are three general regions on tooth surfaces where caries begins: (1) in pits and fissures; (2) on buccal and

labial surfaces near the gum line, and (3) on proximal surfaces close to the contact point on the gingival side.

Caries never begins on the occlusal surfaces of the teeth except in pits and fissures which extend through the enamel into the dentin as a result of faulty formation of the enamel, or in those rare cases where the pits or grooves are abnormally deep and narrow.

When caries begins in pits and fissures, it never spreads on the adjacent surface of the enamel, but develops laterally along the junction of the enamel and dentin, and, at the same time, penetrates through the tubular openings in the dentin toward the central portion of the tooth. Sometimes a large amount of the dentin forming the crown of the tooth will be dissolved and the original opening through the enamel will not have enlarged. The patient may not be aware of decay in that tooth until the weakened enamel gives way under stress of mastication and crushes in, and the tooth is found to be "hollow."

If caries is discovered early in pits and fissures, and the decayed tissue is removed and the cavity filled properly, no recurrence of decay around the margins of that filling will follow and there will be no further decay on that surface of the tooth. Also, if such pits and fissures are ground out and made into smooth grooves with no overhanging walls, so that the food in mastication will sweep thoroughly over all portions of the exposed dentin, there will be no further decay.

Caries does not begin on the enamel of the buccal and labial surfaces where that enamel comes vigorously in contact with food during mastication, unless there be a fault or defect in the enamel surface—a rare occurrence on the buccal and labial surfaces of the teeth. When caries begins on these surfaces, it is on the unscoured portion thereof, close to the gum line and about the center of the unscoured area. In this region, caries spreads superficially toward the gum line but never goes beneath it. It spreads toward the occlusal aspect till it reaches an area where the scouring of the tooth prevents its further progress.

Caries which begins in pits and fissures does not spread on the surface, but penetrates toward the interior of the tooth.

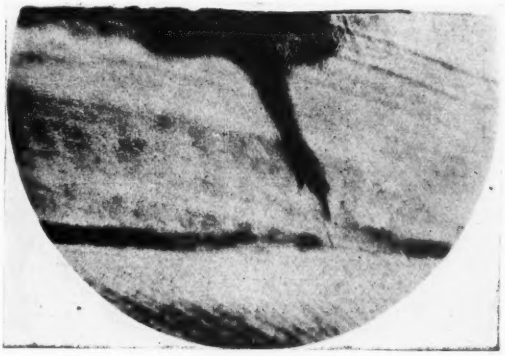

Fig. 6.—Artificial caries that simulates incipient natural caries; produced by lactic acid (p_H 5.0) in twenty-four hours. (×40.)

On the unscoured portions of the buccal and labial surfaces, caries spreads widely over the unscoured area and penetrates the enamel very slowly. We rarely find faults in the enamel on these surfaces. If fillings are made early in cavities of this kind and include all the injured area, but do not reach the gum line or scoured areas near the angles of the tooth, decay will continue around the best type of filling. Such decay will recur until the cavity outlines are extended to a point where the margins of the filling will be exposed to friction by the food. When fillings are thus extended on these surfaces, decay stops and does not recur.

Caries does not begin upon a proximal surface until the septal gum tissue between the teeth recedes from beneath the contact points and leaves exposed an area of proximal tooth surface which is not scoured by the food. Such cavities never extend occlusally beyond the height of lateral convexity on the proximal surface of the tooth, and their extension buccolingually is limited by the friction of the food as it sweeps through the buccal and lingual embrasures.

In the case of proximal surface caries, if the approximating tooth is removed before the cavity has penetrated through the enamel and involved the dentin, such decay usually becomes inhibited because the food sweeping through the space left by the missing tooth cleans that proximal surface and prevents further destruction of the enamel.

In the deciduous teeth, it is a common experience to find incipient proximal decay on the incisors and cuspid teeth becoming inhibited as these teeth separate because of the expanding of the growing jaw, which creates spaces between the teeth and permits food to pass through and keep those surfaces scoured.

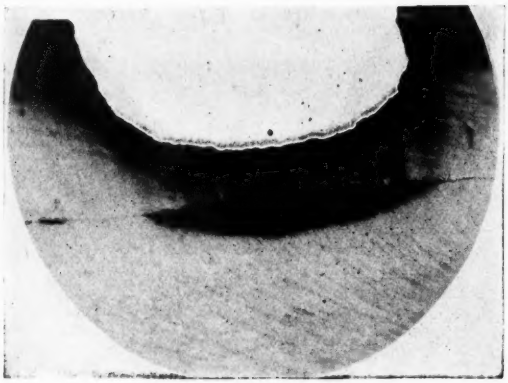

Fig. 7.—More advanced artificial caries, with beginning spread of process at dentinoenamel junction typical of natural caries; produced by lactic acid (p_H 4.6) in fourteen days. (×40.)

In mouths where the teeth have natural spaces between them and are not in close contact with each other, proximal decay is rare. This can be due only to the scouring of food through those spaces, keeping the proximal surfaces clean.

Dental caries almost never occurs on the lingual surfaces of the teeth except in those cases of abnormal tooth formation where pits and fissures (due to developmental faults) are present, as oc-

casionally occurs in the upper central and lateral incisors.

In neglected mouths, if cavities are progressing on the other surfaces of the teeth, they are rarely found on the lingual surfaces because of the frequent and intimate contact of these surfaces with the food and tongue during mastication.

Clinical experience clearly demonstrates that there is nothing vital in the enamel of the teeth that prevents or repairs the lesions of caries. The localization of caries in its beginnings is clearly due to the fact that these susceptible areas are least disturbed by the friction of food.

When the tooth structure is poorly formed owing to malnutrition during the formative period, it is not more subject to attack by caries than is sound tooth structure, unless it presents protected areas or spots not scoured by food. Hypoplastic teeth are frequently unaffected by caries when the hypoplastic areas are limited to portions of the tooth surface which are readily scoured in mastication. Such teeth, once attacked, succumb more rapidly because of their defective structure.

Decay seldom begins at the axial angles of a tooth when that tooth occupies its normal position in the arch, but if a tooth is found out of position and the axial angle is so placed as to be no longer exposed to friction, cavities readily occur at the angle. In teeth with a quarter turn in the arch and the normal lingual surface of the tooth in contact with an approximating tooth, caries readily begins on the lingual surface.

In irregularity of the teeth, for instance where one incisor is overlapped by

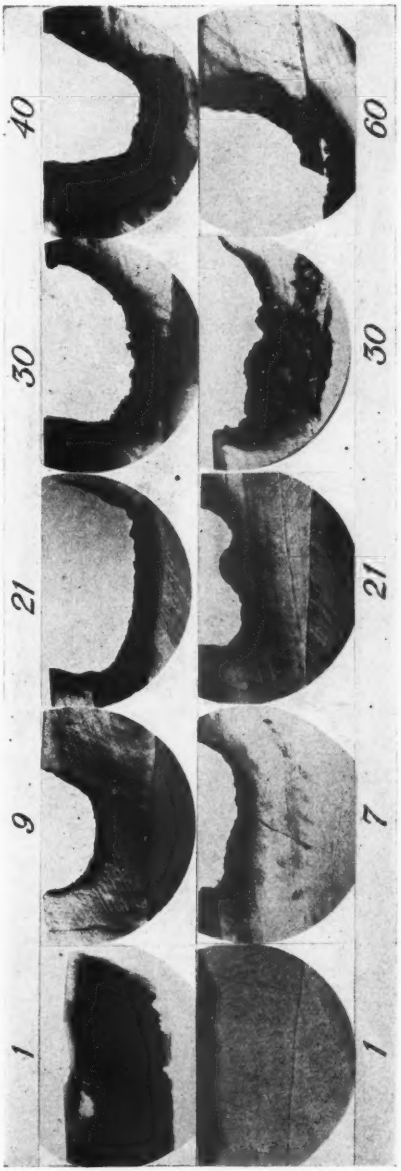

Fig. 8.—Effects of lactate buffer solutions (p_H 4.0) on enamel. (×20.) Left: Series 1, not previously saturated with tricalcium phosphate. Right: Series 2, previously saturated with tricalcium phosphate. The marginal numbers indicate the respective number of days of immersion.

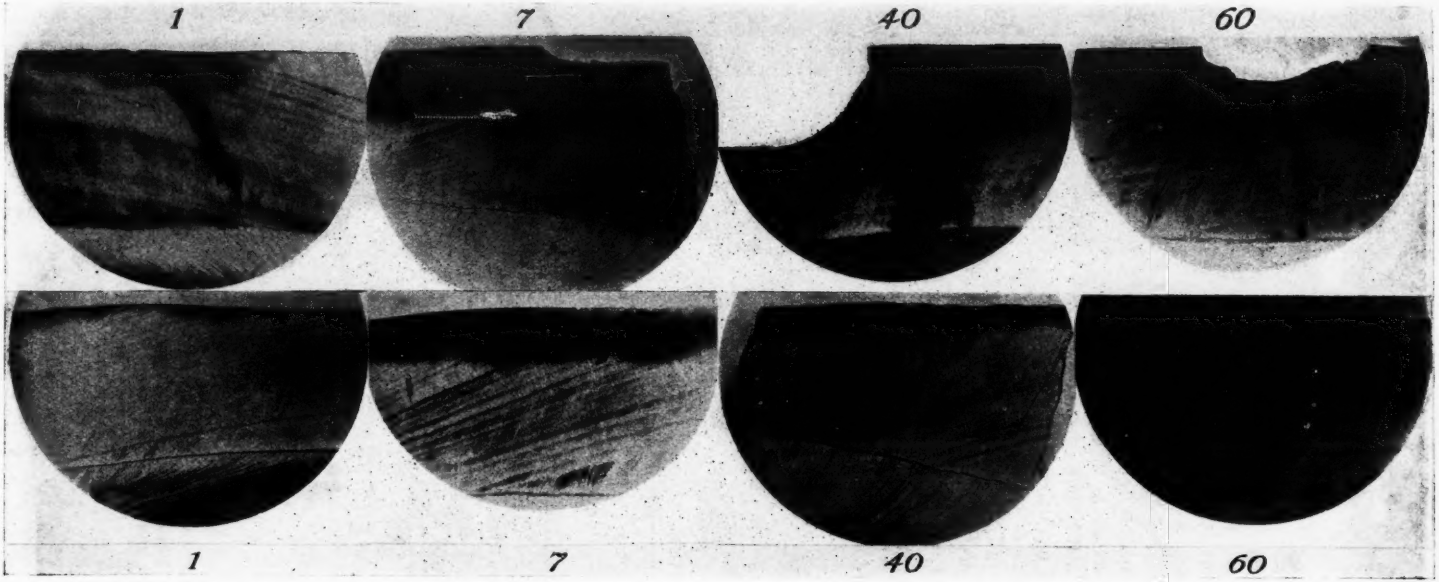

Fig. 9.—Effects of lactic buffer solutions (p_H 5.0) on enamel. (×30.) Above: Series 3, not previously saturated with tricalcium phosphate. Below: Series 4, previously saturated with tricalcium phosphate. The marginal numbers indicate the respective number of days of immersion.

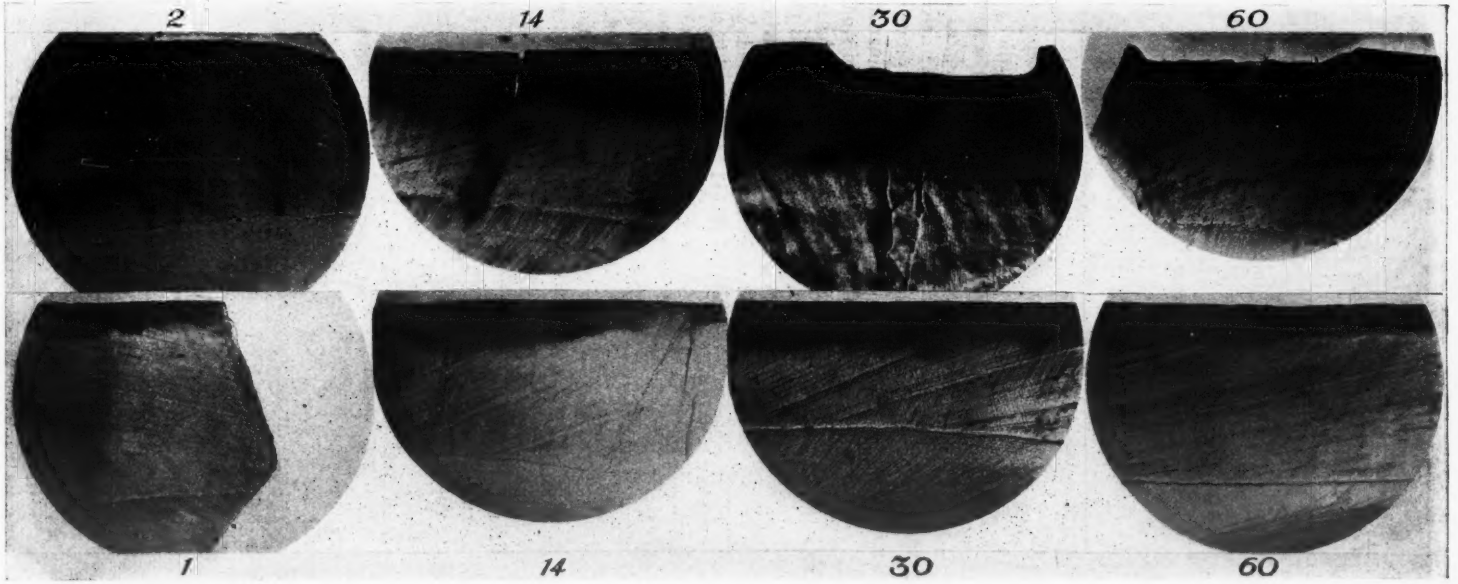

Fig. 10.—Effects of citrate buffer solutions (p_H 6.8) on enamel. (×30.) Above: Series 5, not previously saturated with tricalcium phosphate. Below: Series 6, previously saturated with tricalcium phosphate. The marginal numbers indicate the respective numbers of days of immersion.

its neighbor and caries begins on the proximal surface, the carious area will follow the surface lapped by the approximating tooth rather than take the ordinary form of proximal decay in a tooth in its normal position.

If a clasp or appliance is closely fitted to a tooth and improperly cemented at a given spot, fairly rapid caries can be induced in a mouth that is otherwise free from decay.

It is common clinical experience to find rapid decay taking place under a leaky filling, owing to poor adaptation of the filling material to the cavity walls, when decay is not present elsewhere in the mouth.

The fact that caries never occurs or progresses under a deposit of tartar on the teeth confirms the contention that caries always begins on the outside of the tooth and progresses inward, and never from the inside out.

When it was the custom to transplant teeth, or to attach the crowns of human teeth to artificial plates, it was found that caries frequently attacked such teeth exactly as it did other normal teeth in the same mouth.

Caries is a slow process and may be progressing microscopically for a considerable period of time before definite injury of the tooth structure can be recognized. On those surfaces of the tooth which are frequently scoured and polished by the friction of food, decay does not occur. This clinical observation has given rise to the statement that if a tooth is kept clean, it will not decay. It does not decay on those surfaces that are kept clean. If the areas that are most susceptible to the beginnings of decay can be cleaned with sufficient frequency, decay will not occur on those areas.

Skilful, conscientious operators who observe the areas of tooth surfaces that are susceptible to attacks from caries, and who, in preparing cavities, include all of such areas in the cavity outline, obtain clinical results that confirm the fact that dental caries always begins on the outer surface of a tooth and that, if the surface is properly protected by a filling, the tooth will be preserved against recurrence of caries.

PLAN OF EXPERIMENTAL ATTACK

Consideration of the merits of the views of the two groups brought us to the conclusion that Miller's theories, while not sufficiently far-reaching, could be more logically correlated with the clinical disease; while the defects in the theory of the nutritional group give little promise of possible elimination. Therefore, the following plan of study was designed, first, to consider the seriousness of the objections to Miller's theory and to determine whether certain of these objections could be removed. Secondly, if success should be attained in substantiating Miller's main conception, we planned a comprehensive study of the effects of acids on enamel, the need for which could not be overemphasized. Further, a study of the effects of variation in saliva on the progress of dental caries and, finally, a bacteriologic survey of carious enamel processes were planned.

AN EVALUATION OF THE OBJECTIONS TO MILLER'S THEORY

One of the objections recorded against Miller's theory is that there is no experimental evidence presented to explain why the natural carious process often comes to a halt. We believe that we have found a new and sound explanation of this phenomenon. The lead to this discovery came from a discussion by Beust, who reports that "if you take a tooth with incipient caries that as yet exhibits no break in surface continuity, and immerse it in lactic acid, you will be surprised to find that the sound enamel will be de-

calcified and the decayed part remain."

This statement, if confirmed, required serious consideration in any study of the cause and nature of caries. To determine its validity, thirty teeth with incipient caries were immersed in normal lactic acid for twenty-four hours. Examination of the teeth at the end of this period indicated that Beust's statement was true in the case of twenty-six of the thirty teeth.

The areas insoluble in lactic acid were on the proximal surfaces of the teeth at a place in which caries is usually found. After immersion, these appeared as flat tables projecting from the surface of the more normal enamel, which had been in part dissolved away by the acid. (Fig. 1.) The surfaces of the raised areas were sometimes opaque (white) and at other times glistening like normal enamel. Occasionally, they were visible to the naked eye. Furthermore, in one tooth that had definite cavity formation on one proximal surface, enamel immediately surrounding the cavity was more insoluble even in 5 normal nitric acid than were other parts of enamel of the same tooth. (Figs. 2-3.)

In an early experiment, twelve teeth with incipient caries were exposed to 5 normal nitric acid. After twenty minutes, the teeth showed insoluble areas of enamel of a different contour from the insoluble areas resulting from immersion in lactic acid. The nitric acid allowed more sharp pointed projections to remain, with the exception of two teeth on which a demonstration of an early proximal carious area resulted in an original manner. Figures 4 and 5 show a front and side view of such an insoluble projection from the proximal area.

The possible connection between these discoveries and a sound explanation of the cessation in natural carious processes came to light when we discovered why the incipient carious areas were no longer subject to an acid decalcification process. A tooth showing a projection on each proximal surface after immersion in nitric acid was submitted to the following procedure: One of the insoluble projections was held in a Bunsen flame. Charring took place immediately. The carbonaceous material was completely oxidized by the flame in the presence of oxygen and the projection examined macroscopically. No change other than the loss of the charred matter was noted in its appearance. When the tooth was immersed in the same nitric acid which originally caused the disclosure of the two projections, the insoluble area which had been freed from organic matter quickly went into solution, while the other persisted.

Another objection to Miller's theory was that artificial acid decalcification of enamel does not simulate natural caries in allowing a surface continuity to exist concurrently with evidence of the carious process spreading at the dentino-enamel junction directly under the intact carious enamel.

In our efforts to obtain artificial caries that simulated natural lesions, we exposed small areas on the labial surface of extracted central incisors through windows in asphaltum coverings, to a wide range of acid concentrations of both lactic and citric acids for periods of time extending from one to sixty days. Two hundred and fifty-two teeth were used in this experiment.

It was relatively easy to obtain artificial lesions that simulated natural incipient caries of the enamel both macroscopically and microscopically. Figure 6 illustrates incipient caries thus produced, while an advanced lesion is shown in Figure 7. The latter was produced by allowing a lactic acid solution of p_H 4.6 to act on the enamel for fourteen days.

Three important advances in our knowledge of the effect of acids on enamel resulted from this part of the investigation in which simple lactate and citrate buffer solutions were used: (1) certain ground sections of artificial caries were found which so closely simulated natural caries that dental histologists would experience difficulty in deciding whether they were sections of artificial or natural caries; (2) not only was Friesell and Vogt's contention that a solution of p_H 7.0 could etch enamel corroborated, but conclusive evidence was also obtained that every buffer solution from p_H 4.0 to p_H 8.0 which we used etched enamel, especially during the longer periods of immersion; and (3) though, as a general rule, the greater the hydrogen-ion concentration of the buffer solution and the longer the period of immersion of the enamel in the solution, the more pronounced was the solvent effect, there were sufficient exceptions to this rule to indicate that different enamels vary in their susceptibility to the action of acids.

Since obviously such solutions would quickly destroy the teeth in the mouth and our observation is that we can have saliva ranging from p_H 6.4 to p_H 8.0 without injury to enamel, a study of saliva was carried out to determine what protective elements the saliva might contain. Specimens of the saliva of 225 persons were studied as to calcium and phosphorus content and the hydrogen-ion concentration.

As a result, we learned that saliva is not only saturated with respect to tricalcium phosphate, but even supersaturated.

These results made possible a closer simulation of buffer solutions to the condition of saliva in the mouth, and a second series of decalcifying experiments was carried out with 210 teeth.

The results obtained indicated that the saliva markedly protected the enamel in the neutral range or even in the slightly acid or slightly alkaline ranges, but, in the more strongly acid range of p_H 4.0 and p_H 4.6, there was still marked decalcification, as can be seen in Figures 8-10.

BACTERIOLOGIC SURVEY OF CARIOUS AND NONCARIOUS PATIENTS

In 1926, after reaching the conclusion that the bacteriochemical theory of dental caries was fundamentally sound, the bacteriologic phase of the investigation was started. The published reports of four of the outstanding studies of the last decade on the bacterial flora of carious cases were in agreement as to the importance of lactobacilli in the causation of caries. These findings of Bunting, Rodriguez, McIntosh and Jay were so suggestive of the importance of lactobacilli in the causation of caries that tests were instituted to check their work, on 148 patients.

Of the 148 patients, eighty-five had incipient caries and sixty-three were "immune" on the first clinical examination, when the bacteriologic specimens were collected. An attempted correlation of the findings of the bacteriologic with the clinical examination gave only confusing information. It was found that this was due chiefly to the fact that diagnosis from one clinical and one bacteriologic examination is very misleading. This discovery was made when fifty of the 148 patients were subjected to the follow-up examinations at from three to ten months after the first diagnosis. The repetition of clinical examinations showed often that what we had thought from the first examination was progressive caries was not this type at all, and many of the "immune" cases showed, on subsequent examinations, that they were affected with progressive caries of the enamel.

Even when attention was concentrated on the relation of the lactobacilli isolated

by acid broth to the clinical diagnosis of one examination, the same misleading information was manifest. Of the eighty-five patients exhibiting incipient caries, fifty-three, or 61 per cent, had lactobacilli present, and of the sixty-three without caries, thirty-three, or 52 per cent, showed the presence of lactobacilli also. This evidence certainly does not indicate the importance of lactobacilli as factors in the etiology of caries of the enamel, but neither does it contraindicate it to one who considers the condition that would exist if the bacteriochemical theory of tooth decay is true. If acid from fermented carbohydrates causes dental caries, it is obvious that there are periods when the bacteria conducive to caries are present but have as yet produced no lesion observable microscopically or with the aid of an explorer. There also might be lesions which, to all outward appearances, are active, but have lost the harmful micro-organisms. Dependence on one clinical and bacteriologic examination might easily produce a confusing state of affairs in attempted correlation of data.

A system of follow-up examinations seems to be the dependable method of determining whether caries is active or arrested and whether certain micro-organisms are significant in the carious process. This is demonstrated in the results of our study of the fifty patients who were subjected to follow-up examinations. If we take into account only the evidence from the first examination, no suggestion is found that lactobacilli are important factors. Thirty-five of the fifty cases were noncarious. Of these eighteen were positive for lactobacilli and seventeen negative. Of the fifteen carious cases, nine were positive for lactobacilli and six negative. On making follow-up examinations from three to nine months after the first, it was found that the six cases of incipient caries without lactobacilli had not advanced, while, of the nine cases of incipient caries with lactobacilli present on the first examination, five had become advanced caries. We have here strong circumstantial evidence of the importance of lactobacilli in the carious process.

This is especially true when, on further consideration of the thirty-five noncarious cases, it was found that thirteen of the eighteen cases which were positive for lactobacilli on the first examination had developed caries by the time of the second examination from three to four months later; whereas, sixteen of the seventeen cases that were negative for lactobacilli on the first examination were still caries-free on the second examination. From the evidence thus gathered, the inference was made in 1927 that the bacteriologic findings with respect to the presence or absence of lactobacilli seemed to be a true prognostic indicator of the clinical findings that would be observed on clinical examination from three to six months later. Jay came to this conclusion independently, as is evidenced in his report of 1929.

The results of the more general investigation were recorded only with respect to the fifty patients who were subjected to the follow-up examination. The extent of this general bacteriologic phase of the study has been so small that the evidence cannot be convincing. The general agreement in evidence from the study of the effect of acids on enamel compared with that from our general bacteriologic investigations plus the similar results of Bunting, Rodriguez, Jay and MacIntosh prompted us to defer further bacteriologic and clinical study until a satisfactory dental antiseptic could be found that would allow us to kill, or at least to reduce appreciably, the lactobacilli in food débris on the teeth of patients suffering from caries at will. At the present time, carefully controlled clinical tests are be-

ing carried out to determine whether a reduction of the lactobacillus infection of the dental zone is accompanied by a decrease in the incidence of new caries. These tests are not complete, but are already giving results that confirm the importance of the lactobacilli in the causation of tooth decay. This work when finished will be reported in a later communication.

SUMMARY AND CONCLUSIONS

1. An extensive study of the literature and experimental investigations of the cause and nature of dental caries indicate that local environmental conditions are the main factors in the active causation of decay of fully erupted enamel and that deficient diet and defective nutrition are the important factors during the developmental period of the teeth in that these are responsible for construction of teeth more susceptible to the action of the acids of fermentation. These studies also indicate that improper diet and defective nutrition are of some though minor importance as a predisposing factor in caries of enamel, being responsible for an environment of saliva low in calcium phosphate content.

2. It has been proved possible to produce artificial lesions that simulate natural caries of the enamel.

3. The cessation that is sometimes observed in carious processes of the enamel is due to the presence of acid insoluble protective organic coatings.

4. Simple lactate and citrate buffer solutions from p_H 4.0 to p_H 8.0 may dissolve tooth enamel in immersion periods of sufficient length.

5. Different tooth enamels vary in their susceptibility to the action of acids.

6. Human saliva is generally saturated with respect to tricalcium phosphate.

7. Lactate and citrate buffer solutions previously saturated with tricalcium phosphate dissolve enamel only at hydrogen-ion concentrations greater than p_H 5.0.

8. The only micro-organism that is commonly found in the food débris in direct contact with areas of progressive caries of the enamel and that can tolerate and grow in an environment more acid than p_H 5.0 is a lactobacillus of the following characteristics: a gram-positive rod which produces usually a smooth colony, acid and no gas in dextrose, levulose, galactose, maltose, lactose, sucrose, mannitol, sorbitol, salicin and dextrin. This type produces neither acid nor gas in arabinose, xylose, raffinose and inulin. Its final p_H in glucose-tomato broth generally ranges from 3.6 to 4.0. It can grow at a temperature of 15 C. It is agglutinated in high dilution by *L. acidophilus,* Y type, antiserum which does not agglutinate at all *L. acidophilus,* X type.

We made a detailed study of the biochemical characteristics of thirty of the dental strains of lactobacilli. As a result, we were able to separate them into two main groups. Thirteen of the strains agreed in all fermentation and serologic characteristics. Of these thirteen, we selected one for comparison with the commonly found strains of Bunting, Rodriguez, and Morishita, and found that these strains were all identical.

COMPARISON OF DENTAL STRAINS WITH INTESTINAL STRAINS

As a result of these studies, it was decided to call the dental strain *Lactobacillus acidophilus,* Y type. The detailed characteristics that were investigated with relation to all the strains of lactobacilli have been organized into a classification scheme for stable strains.

These results are given in detail in the full report of the research.[2]

2. Enright, J. J.; Friesell, H. E., and Trescher, M. S.: J. D. Res., 12:759 (Oct.) 1932.

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Editorials

THE ETHICS OF SPLIT FEES

"The Ethics of Split Fees"! We beg pardon—there is no such thing as ethics in the practice of split fees. From time immemorial, at least from the time that medicine and dentistry became possessed of a professional status, there has cropped out on occasion this menace of fee splitting, and it is one of the most pernicious practices that has ever crept into professional life. In fact it nullifies real professionalism at its very source. This hydra-headed monster of perfidy and ill-repute vitiates every principle of equity and correct living.

In commercial life, it has always been known as graft, and the term has invariably carried with it the stigma of unfairness and iniquity. In later years, another phrase has crept in, with a more subtle and deeper dyed significance. "It's a racket" has rung the changes through the lay press till its very name has become a stench in the land.

And if this practice is reprehensible in commercial life, what shall we say of it when it invades professional life? Never in the whole category of ethical lapses has there ever been a more demoralizing or unjust practice than this, never anything that so saps the morale of every individual connected with it.

Here is the situation in a nutshell: If a general practitioner refers a patient to a specialist, there is only one possible justification for such a procedure: the general practitioner does not care to do that kind of work or he knows that the specialist can perform the service more skilfully. In either of these cases, the general practitioner is under deep obligation to the specialist for relieving him of facing an uncomfortable problem, and if any compensation passes between them, the general practitioner should really reimburse the specialist for accepting a service that to the general practitioner would have been irksome.

If, on the other hand, the specialist contributes anything in the way of a commission to the general practitioner, either one of two things happens: To the extent that the specialist pays the general practitioner out of the money received from the patient, the specialist is being robbed, provided the fee has been legitimate. In case the specialist charges a fee sufficient to reimburse himself and also enough to pay the general practitioner a commission, he is robbing the patient. There is absolutely no escape from this logic. All of the palaver and specious reasoning possible will not minimize the dishonesty of this procedure. The whole transaction is false on its face, and cannot be condoned by any sort of sophistry.

In 1909, the Illinois State Dental Society adopted a code of ethics one provision of which made it unethical to pay or accept commissions on referred practice, and this has been a provision of the Illinois code ever since. At the Los Angeles meeting of the American Dental Association in 1922, a similar regulation was voted unanimously, and this also has been on the statute books from that time till the present. It is conceivable that, in all that period, there have been surreptitious violations of the code in this respect on the part of otherwise ethical men, because of the

temptation that assails individuals to get something for nothing; in other words, to profit at the expense of the earnings of someone else.

Human nature has not yet achieved the ineffable perfection of being above this kind of wrong, but there is one thing that every violator should remember: Any member of a dental society that is a component of the American Dental Association who pays or accepts a commission renders himself liable to discipline, and in case of wilful persistence in violation, he may be expelled from the society.

Fee splitting, if it should ever become prevalent in the profession, would spell the end of ethics and all honorable conduct in the practice of dentistry. There is no other influence that would so vitiate professional or individual welfare as this, nothing that would so demoralize dentistry and make it a by-word in the land. If racketeering is an ugly word in commercial life, what shall be said of it in professional life? Words are inadequate to express the obliquity of this practice. It is reprehensible in every way and it violates all the finer impulses of honor and correct living. Nothing in the world can be said in justification of it; everything possible should be urged against it.

Yet may we not pause to discover for a moment whether there is not after all a very natural explanation of the manner in which this degrading practice began? May we not find in our hearts some charity for the men of long ago who first indulged in this dereliction, and even for certain of the men of today who have fallen into this custom without a full realization of all that is involved in it? In the early days when medicine and dentistry were first struggling to establish a professional status, the ethical distinctions between commercial life and professional life were not so closely drawn as they are today, and the ethical behavior of men was not so intimately scrutinized. Professional ethics has been of slow growth, and it is safe to assume that the highest expression of the ethics of commercial life today is no whit better than was the ethics of professional life in the early days. The ethical lapses of our present civilization are sad enough in all

conscience, but they are as nothing compared with the current practices of the "good old days"—the days when assassination was a legitimate political weapon, and they piously burned people at the stake.

After all, the most exalted concept of our best civilization today contemplates a higher recognition of the rights of man, and what was condoned in the early days can no longer pass muster among honorable men.

Fee splitting is an expression of the baser side of life. It should be considered anathema by all honorable individuals, and the time must come when it is no longer tolerated in the profession.

MAIL ORDER DENTISTRY

Another blatant imposition on the profession and the people has come to light in the past few months. Mail order dentistry with a vengeance has been advertised to the public through the medium of the newspapers, and unsuspecting people have been imposed on to the extent of no one knows how many dollars.

The brilliant idea was evolved of sending to the prospective victim by mail a wad of impression material, which was to be warmed by the patient and used as a medium for his taking his own impression by biting into it. The resultant product was then mailed to the advertiser, and from this a denture was to be constructed and returned to the patient at so much per denture. A deposit was required before any work was done.

The extent of this imposition can never be definitely known, but the matter has finally reached the courts, and the dentists advocating the scheme are being prosecuted by the state board of dental examiners. The outcome will be announced when the case is decided. Verily, "a sucker is born every minute," and sometimes it would seem that the crop was even more abundant than that.

To the honor of some newspapers, advertising of this character is not admitted to their pages, and these newspapers should receive the thanks, the endorsement and the support of self-respecting people everywhere; which brings up the question of the people's right

to protection from nefarious advertising schemes of this character. When it comes to the physical welfare of the people, there is a fundamental duty devolving on publications of all kinds that innocent readers be not victimized or, it may be in some instances, even seriously injured through unworthy propaganda introduced in their advertising pages.

While there is apparent a serious effort on the part of lay and professional publications of the more reputable sort to purify advertising and winnow out of it false claims and misleading propaganda, there remains much to be desired in the way of eliminating advertising that is on the border line of authenticity and respectability. There is a constant straining on the leash by the dogs of sensationalism and commercialism, and they must be held at bay by the firm hand of conservatism and honorable dealing. But it is not so easy to bring about reforms of this sort as might at first blush seem the case. Advertising in itself is not necessarily venal. In its essence, it is merely the means of bringing to the attention of people who require commodities or service the most direct route to the satisfaction of their needs. It is only when a wrong is done by misrepresentation that harm results.

Our profession is frequently charged with negligence in not more strenuously combating the evil influences of pernicious advertising in the public press, but it may sometimes be found rather difficult to draw the line.

Yet there is always this to be said: The moment that false doctrine is promulgated to the extent of fostering deception and injuring the public, it is the bounden duty of all good citizens, dentists as well as others, to suppress it in every conceivable way. And there is also this, that when the stable foundations of the profession were originally laid down, there was formulated a certain code of ethics which became the very bone and sinew of our professional faith, and without which we could never function as a real profession. In all the years during which a professional standard has been maintained through the agency of the code, one of the provisions has had to do with the subject of advertising in the public press.

Much contention and misunderstanding have resulted over this question, and there are certain members of the profession who argue that the code is too restricted, and that certain kinds of advertising should be permitted. We may admit that the widest possible publicity should be given to the education of the public on matters pertaining to dentistry. The people need to know more about the teeth than they do; of this, there is evidence every day. But it is a different matter to advertise dentists themselves in a public manner. To magnify an individual in this way is an offense to good taste and common decency, and mail order dentistry is a species of personal exploitation of this sort at the expense of the public weal. Out with it wholly and forever.

LORD RIDDELL

On another page, we publish an address by the Right Honorable Lord Riddell, which was sent us by Dr. Harvey J. Burkhart, director of the Rochester Dental Dispensary. Lord Riddell is prominent in benevolent and philanthropic work of all kinds in England. He was an old friend and admirer of the late George Eastman, and is president of the Eastman Dental Clinic in London, toward which he contributed a quarter of a million dollars, as also did Sir Albert Levy.

Lord Riddell is one of the leading men of England. He is famous as an orator and after-dinner speaker, and is in demand on all occasions. He is a lawyer by profession, but for many years he has been interested in newspaper and magazine work. He owns the "News of the World," "John O'London" and other publications. He was intimately associated with Lloyd George during the war, and in charge of news publicity at the Versailles Peace Conference in Paris, and the Naval Conference at Washington during the Harding administration.

He is an all-round fine gentleman, and our profession is greatly indebted to him for the keen interest he has taken in the dental care of children and particularly in the Eastman Clinic.

WILLIAM H. TAGGART, D.D.S.
(1855-1933)

Obituary

WILLIAM H. TAGGART, D.D.S.

(1855-1933)

William H. Taggart was born in Freeport, Ill., March 23, 1855, and died at his home in Chicago, April 17, 1933, from apoplexy, after a long illness.

He was educated in the schools of his native city, and later attended Philadelphia Dental College, from which he was graduated in 1878. He established himself in practice in Freeport, and later moved to Chicago, where he conducted a successful practice for many years.

He was president of the Illinois State Dental Society in 1892, and of the Chicago Dental Society in 1905. He was a member of Delta Sigma Delta Fraternity.

Dr. Taggart early demonstrated an unusual talent for excellence of technic, which culminated in his invention of the cast gold inlay in 1907. From this time forward, he devoted himself wholly to the perfection of his inventions, and the manufacture of his products, and he was instrumental in bringing out many useful devices that have added to the armamentarium of the dentist, and greatly enriched the profession. The widespread applicability of the cast inlay soon led to other achievements in casting technic and paved the way to a much broader field in partial denture and even in full denture construction. In fact, it is not too much to claim that the casting process revolutionized the practice of dentistry, enabling the profession to deliver a more efficient service and with the expenditure of greatly reduced effort. Doubtless it has prolonged the lives of countless numbers of our calling, and made the pathway easier for all of those who practice our profession. The contributions of Dr. Taggart have extended to all corners of the earth, and his name is known wherever modern dentistry is practiced.

He is survived by his widow, a daughter, who is the wife of Lt. Commander E. B. Lapham, U. S. Navy, Dallas, Texas, and by his sister, Miss Belle Taggart of Freeport, Ill. Interment was at Freeport.

BUREAU OF PUBLIC RELATIONS

MOUTH HYGIENE IN MISSISSIPPI

By GLADYS EYRICH,* Jackson, Miss.

WHEN, in the Spring of 1932, the state appropriation for public health work in Mississippi was cut 33⅓ per cent and other funds were decreased, it became necessary to lessen the amount allotted to mouth hygiene. Services of four itinerant hygienists (three white and one colored) and a full-time secretary were discontinued. The school hygienist in Laurel was likewise eliminated. Except for four county dental workers, the mouth hygiene program is now being carried on by the supervisor and two part-time office helpers. With these curtailments and a reduced expense account, it was evident that activities for 1932-1933 would be limited.

After consultation with the dental member of the state board of health and the council on mouth hygiene and public instruction, the following objectives were set: 1. To offer assistance to programs now in operation. 2. To respond to requests for help in conducting a program.

This confines the visits of the supervisor to those counties demonstrating interest. Certain exceptions to this rule have been made when the supervisor had time open and could visit a county with another state health worker, thus eliminating the expense of transportation.

Other conditions, directly or indirectly due to the economic situation, are limiting the program, particularly with reference to dental inspections and corrections.

For brevity and convenience, the various phases of the state programs are given in outline.

Prenatal: Complete program of inspection and consultation in four counties having dental workers.

Preschool: Complete program of inspection and consultation with parents in four counties having dental workers. Prophylaxis for those attending conferences in two of these counties. Incomplete program of inspection and consultation with parents in other full-time counties, supervisor or dentists assisting.

School: Dental inspections twice yearly in two counties with dental workers; once yearly in three-fourths of all counties. Total inspections about 100,000. (Estimate less for 1932-1933, based on volunteer work of dentists.) Follow-up of inspections by letters to parents and classroom and assembly talks by supervisor in about forty counties. Materials for teachers distributed.

College: Classroom and assembly talks by supervisor.

Adult: Addresses at county teachers' and parent-teacher meetings, and to other adult groups.

Negroes: Same program, reaching fewer negroes.

Rural: Complete program, including prenatal, preschool, negro and school groups in three counties. Complete program including prenatal, preschool and school groups in one

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county. Incomplete program, chiefly to school group in other counties. (Of a total number of 683 schools inspected in the 1931-1932 school term, 70 per cent were rural schools.)

The prenatal mouth hygiene program will continue as heretofore, since it is conducted in counties having dental hygienists.

The preschool work each year shows an increasing number having dental corrections, with a more understanding attitude on the part of the parents. In one county, last spring, a total of 491 children were inspected by the hygienists, 309, or 62 per cent being in perfect condition, 24 per cent having visited a dentist. Of these, 281 had their teeth cleaned, a few being as young as 18 months.

Several developments in the school program are interesting. When Laurel lost the dental hygienist who had worked there seven years, the school authorities, with the P. T. A. council, formulated a plan of inspections by the dentists in their offices. Two slips were sent to parents: No. 1 requesting the parent to write the dentist's name on a card and send the child to him for inspection; No. 2 asking the dentist to enter the mouth condition on the card. These slips were sent out from one school at a time so that the dentists would not be overcrowded with work for the children. In January, five schools with an enrollment of 1,573 had 70 per cent examined, with 45 per cent in perfect condition. That 70 per cent of the total enrollment cooperate by going for inspection proves the plan workable. It eliminates "shopping" around for certificates and insures that the inspection be made by the dentist of the parents' choice. It is interesting that the school having the largest percentage of the enrolled pupils inspected likewise had the largest percentage in perfect condition. The school having the smallest percentage inspected is made up of the oldest children, those in grades 5-6. This school may have received its notices late; but the situation suggests that the older children respond less readily to the health work.

In Louisville, the mothers' club fostered dental inspection in the dentists' offices. By March, 60 per cent of the first eight grades, enrolling 562 pupils, held their dental certificates. Clarksdale, having a well balanced health program for years, had 72 per cent of the total enrollment of 1,275, with certificates in October, and by February, two schools had 100 per cent corrections, one of them including 512 children. Canton, with no health worker in the county, continues to show the good results of a consistent yearly mouth hygiene program. In the elementary school, there were 447 pupils enrolled, 45 per cent rural children. November 29, only ninety lacked their dental certificates. This work is financed by the parents, the dentists contributing liberally for worthy indigent children. There are no clinics in the state.

The percentage of good mouths for the state remains the same as it has for the past five years, about 43. In schools where it is thought unwise to urge corrections, some good work has been done in brushing the teeth and increasing the number bringing milk for lunch.

Because of twelve weeks spent in study during the past two summers, the supervisor made very little contact with the teachers at the state colleges during their summer terms. Through arrangements made with the education departments of five colleges, classroom and assembly talks were made during January and February to classes in education, hygiene, home economics, physical education and science. In some colleges, the entire student body was reached; in others, only those students who hoped to teach next

year. In these talks, emphasis was placed upon teaching mouth hygiene in accord with the best principles of health education. These visits to colleges, to county teachers' meetings or to parent-teacher associations are made the focal point around which a week's activity is arranged.

During the nine months last year when a negro dental hygienist was employed, her work included the negro schools where teachers are trained and towns where the negro dentists practice. She inspected 17,670 mouths in fifteen counties, finding 38 per cent in perfect condition, which was somewhat under the percentage among the whites, owing to the fact that less corrective work had been done. This year, in two of the counties having dental hygienists, inspections and instructions are given all schools; the other two hygienists conduct programs in the largest schools; the supervisor speaks at negro schools and normals whenever possible, and aids for teaching mouth hygiene are furnished the colored teachers.

Since of the 2,000,000 population in Mississippi, 83.1 per cent is rural, a large percentage of all health work is directed toward this group. Especially is this true in the twenty-nine counties having full-time health departments, which in 1931-1932 served one-half the entire population of the State. As stated in the outline, 70 per cent of the inspections during last year were conducted in rural schools, which indicates with fair accuracy where other phases of mouth hygiene were emphasized. Considering that these 2,000,000 people have only 378 white and thirty-three colored dentists; that the majority of these dentists are in the urban areas and the people in the country; that the per capita wealth is largely in turnip greens, sweet potatoes and sunshine, one can realize there is much to be done.

Comparing mouth conditions and attitudes toward mouth hygiene now with those ten years ago when the program started, much has been done. What one, stimulated rather than conquered by unfavorable circumstances, may do is a constant challenge.

ACTIVITIES OF THE MICHIGAN DEPARTMENT OF HEALTH, BUREAU OF MOUTH HYGIENE

By WILLIAM R. DAVIS,* D.D.S., Lansing, Mich.

NECESSITY confines the work of the bureau of mouth hygiene to education concerning the extent, effect on health and causes of lesions of the mouth and teeth, together with the best means of prevention and correction. The bureau activities include lectures, demonstration examinations, consultations and the provision of educational material and programs. The personnel of the bureau consists of a director and a part-time stenographer.

*Director of Bureau of Mouth Hygiene, Michigan Department of Health.

LECTURES

Individual lectures accomplish little unless there is contact with school or community leaders and the dental profession,

which promises adequate follow-up with a definite program. Consequently, while an endeavor is made to take care of the demand which comes to the department for individual lectures on our subject, there is also an attempt to make these an occasion for other vital contacts. All lectures and consultations in the remote sections are grouped in order to conserve time and travel and, in this way, it is possible to cover more of the state and at less expense.

NORMAL SCHOOLS

In cooperation with the bureaus of education and child hygiene and the state department of public instruction, lectures are given before classes in nearly all the normals of the state. When it is realized that Michigan has forty-eight county normals, where a one year course is given especially for rural teachers, and four state normals, this contact alone is seen as a major task. However, the importance of the teacher in health promotion cannot be overestimated. These lectures have been most cordially received and have now been continued long enough to afford the bureau concrete evidence of their value from teachers who have had this training.

DEMONSTRATION EXAMINATIONS

Early in the state activities, it was found most valuable, in connection with lecture work, to be prepared to examine a small group of children carefully with mouth mirror and explorer as a demonstration before community leaders, teachers or normal students. This procedure furnishes proof of the appalling need for mouth hygiene, and also of the fact that a tongue blade examination misses defects at the most favorable time for filling. Moreover, it also gives a cross-section of actual conditions and, if continued, affords concrete evidence of progress. The demand for this type of education persists; in fact, it is universally commented on for its practical value. Incidentally, the demonstration examinations last year in connection with county normal lectures showed an average dental improvement in the children in the critic rooms of approximately 20 per cent.

CONSULTATIONS

Consultations have to do with a program of education, or the problem of dental care for the indigent or semi-indigent case. The latter is a very much needed health service and, at the same time, a difficult one, for no rule can be laid down, since no ideal nor even an adequate solution has been found. Conditions differ in each community, and the problem has been worked out, if at all, in accordance with these conditions. Only a few of the larger cities employ a dentist or dentists full time. In other places, a school board may employ a local dentist part time in a school clinic or in his own office. Sometimes, this is divided among local dentists. In some communities, a local organization supplies funds for this purpose. In one consolidated school, the past year, where a small private sum was available, and no local dentist near, the school bus was utilized to convey the children 12 miles to a city where the local dentists set aside one forenoon a week for this purpose until the needed dental service was completed. The dentists were paid a small sum per hour and, when the fund was exhausted, generously continued until the school was cared for.

The problem is to help the community find the most practical and economical solution available.

CLINICS ON CHILDREN'S DENTISTRY

Since the incidence of dental disease is so great among children and since the

dentist must play so large a place in its correction, one of the greatest handicaps to greater progress in mouth health promotion has been the disinclination on the part of a large number of dentists to perform adequate dental service for children. Nothwithstanding continued improvement in this regard, there was evidence that one of the greatest needs was sane, constructive clinics on modern dentistry for children that could be taken directly to the dentist in his locality. This need has now been met by the state dental society. Through its educational committee, of which the director of the bureau of mouth hygiene is a member, an entire afternoon and evening of lectures and practical clinics on children's dentistry by Walter C. McBride, of Detroit, have been put on in seventeen different sections of Michigan, with a concerted effort to interest every ethical dentist whether a member of the state society or not. The value of these clinics is attested by reports from school nurses all over the state who are almost unanimous in stating that the local dentists are showing increased interest in children's dentistry and are cooperating in a satisfactory manner.

DETROIT COLLEGE OF MEDICINE

With other bureau directors of the department, I lecture before the senior class of the Detroit College of Medicine, my subject being "The Place of Mouth Hygiene in Public Health."

THE PRESCHOOL CHILD

Activities in behalf of the preschool child have centered mostly in urging the dentists to cooperate with the summer round-up and examination, in speaking before mothers' clubs and in supplying material for the nursing and prenatal staff of the bureau of child hygiene and public health nursing and for other preschool workers.

THE RURAL POPULATION

Attention to mouth health promotion among the rural population has, I think, been already indicated in the efforts to reach the rural teachers. Many of the most encouraging reports come from the rural districts.

EDUCATIONAL MATERIAL

The aim from the beginning of the work in providing educational material has been to furnish health workers, teachers and other responsible leaders with the facts concerning the mouth in relation to health and means for promoting this phase of health service. Commercial bias and fads have had a tendency to confuse the public mind on this subject, and an endeavor has been made to combat this tendency by emphasizing the simple fundamentals and keeping these in their proper relation as brought forth by scientific research.

One addition to the material the past year has been a short mimeographed, illustrated outline intended especially for the use of the teacher. This has been very favorably received.

The demand for educational material and school blanks continues. No material is sent except on request for samples or for distribution by responsible leaders.

Reports from school nurses and other health workers continue to show encouraging accomplishments in mouth health promotion, although the work is slowed somewhat by economic conditions. The reports also show that many health workers are being laid off, but the extent to which this is going on and its effect on the future is not now evident. They do indicate for the present an increasing dependence on this office for cooperation and assistance.

MARYLAND'S ORAL HYGIENE PROGRAM

By RICHARD C. LEONARD,* D.D.S., Baltimore, Md.

THE idea of a state-wide oral hygiene program originated in the minds of some of Maryland's forward looking members of the dental profession years prior to its inauguration. The trail leading to the actual beginning of the program in 1929 cannot be definitely followed; but the need of some such project was so strongly embedded in the consciousness of an ever-increasing number of dentists that fruition became a fact rather than a hope in 1929.

Two conditions have contributed very largely to the inauguration and success of Maryland's oral hygiene program. These are, first, the unanimous support of the program by organized dentistry in the state when first it was tendered to them and, secondly, the continuation of that support by the state association both as a group and as individuals. It is essential to any health program's success that it have the backing of members of the profession that it represents; that it be *their* program. In Maryland, such cooperation has been an inspiration and a stimulus to the program's director.

The first step was to bring about a change in the law that would permit dental representation on the state board of health, the controlling body of all state-sponsored health activities. A committee of the state dental association charged with the duty of effecting such legislation met with cordial cooperation when their aim was brought before the state board of health and Maryland's governor, Albert C. Ritchie. Their sincerity is attested by the immediate change in the law and the governor's subsequent appointment of Burt B. Ide, of Baltimore, as dental member of the board.

The committee's activity did not cease at this point. They carried on and secured the support of both the board and the governor of a plan to form under the board, as an integral part of the state health department, a division of oral hygiene, with an appropriation enabling the division to conduct a program making for improved mouth health conditions in Maryland children.

(Parenthetically, it should be stated that in Governor Ritchie Maryland has an executive who is alive to the health needs of his state's citizens and who has actively given his support to every project in which betterment of health conditions is the aim.)

All such projects are time consuming, and it was not until late in 1929 that the newly established division, with me as its chief, was able to begin its activites. Again it should be stressed that there could scarcely have been a happier combination of individuals and groups supporting the new program: a governor sympathetic to the project, a board of health cognizant of the state's needs and cooperative to the greatest extent, a dental member of that board during whose administration as president of the state

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dental association an oral hygiene program had been suggested and, finally, a statewide group of organized dentists who were behind the entire plan, and, more important, were of a mind to keep behind it.

In 1929, a survey of existing dental health agencies revealed the usual isolated attempts of various groups to do something toward solving the program of mouth ill-health. These were represented by individual school, city and, in a few cases, county-wide programs, in most of which clinic care of indigent children was the ultimate aim. While some of these projects had been eminently successful, the total lack of unity of conduct, the failure to consider the educational aspect as of primary importance and, in most cases, the limitations of the work accomplished, all pointed to the need of coordinating these existing agencies under the new division. In every case, this coordination was effected to the complete satisfaction of the original sponsors of these isolated clinics.

It is apparent, therefore, that the new division of oral hygiene had before it a clear field in which to begin its activites. It had the experience of other state-wide programs to guide it. What was considered best in the program of one state was selected along with the "best" of another state. Out of these various ideas, Maryland's oral hygiene program was evolved. A brief review of its activities follows.

Fundamentally, Maryland's oral hygiene program is one of education as to the importance of maintaining normal mouth health and the ways by which it may be done. This education is directed, of course, toward the lay people of the state, particularly the children. It is accomplished through undergraduate instruction, teacher training and lay education.

Undergraduate instruction is an answer to the too often repeated, and demonstrated, accusation that the dental profession has been lax in its attitude toward correctional care of young children. The futility of lay education without a corresponding realization of the importance of mouth health and a willingness on the part of private dental practitioners to provide it for *all age* groups is obvious. The reeducation of the established practitioner, or motivating him to practice what he knows, is possible but difficult. Education of the undergraduate is far more practical and may result in influencing the older practitioners to do what their younger confrères assume as a part of their daily practice, that is, thorough, painstaking, preventive dental work for young children.

Briefly, the course consists of instruction in all phases of children's dentistry, from operative instruction to prophylaxis. It includes nutrition and psychology; deciduous tooth embryology and anatomy, and, finally, certain aspects of dental public health which the dental profession seem bound to meet within the next decade.

After graduation, these students furnish the potential material from which dental clinicians, adequately trained for work in the schools of rural Maryland, may be selected. Since the course is under the direction of the chief of the division of oral hygiene (aided by an able corps of instructors), ample opportunity is afforded for observing the aptitude of the men and their ability to carry on, as operators in clinics and as educators of both children and adults.

Teacher training is based on the belief that trained teachers are best equipped to instruct the children under their charge in the basic facts of oral hygiene. Not only are they trained in the best methods of pedagogic approach, but they also have

the opportunity which daily contact with the children gives for repeated emphasis of these facts. Repetition is an important factor in child education.

In Maryland, a course in oral hygiene has been introduced into the curriculum of one of the three state normal schools. Offered first in 1932, it was given in its entirety by the division chief. This year, the course has been more than doubled in scope and the aid of three members of the dental school faculty has been enlisted to assist in giving the course.

The course itself consists of rudimentary facts of oral hygiene, the importance of early recognition of dental ailments, the relation of nutrition to sound teeth, tooth brushing as an inhibitor of caries and kindred subjects tending to give these potential teachers a practical, if not a detailed, knowledge of the teeth and mouth.

Lay education is divided into two phases, the purely educational and the knowledge which is a by-product of clinical demonstration. The former includes talks before lay groups, film showings, pamphlet distribution, press bulletins and radio talks. All of these stress the importance of diet, early and regular dental care and mouth cleanliness in the maintenance of oral health.

The response to this type of health instruction has been gratifying. Mouth health makes a greater appeal to the laity than almost any other phase of health work. Nearly 500 lay talks before P. T. A. and civic groups or via radio have been given by members of the division staff since the start of the program.

The second approach to lay education, through school dental clinics, is undoubtedly the most interesting aspect of the entire oral hygiene program. As already stated, these clinics are primarily intended to serve as educational demonstrations of the importance of the maintenance of mouth health. They also serve as an agency through which children, educated, let us say, to the importance of oral hygiene, but from families unable to provide needed care, may obtain correctional treatment.

In this regard, it should be pointed out that there is a certain degree of futility and possibly danger in an oral hygiene policy that educates to the necessity of mouth care without providing means whereby the newly gained knowledge may be used. The futility is obvious and the danger lies in the fact that continued frustration of a widespread desire to utilize knowledge may create a demand for correctional care from sources not controlled by, or through, the dental profession.

Maryland's school dental clinics vary in scope and conduct. Some are countywide, some limited to one school, some full time, half time or occasional. The state's clinic work does not include similar projects conducted in Baltimore City under the city health department. Some of the clinicians employed by the division are full time salaried dentists, others, local practitioners devoting half or less time to clinic work at a *per diem* salary. Some clinics offer entirely free service to the indigent only, others free and low cost (a flat rate per child) service to the indigent and the near indigent, respectively. One experiment is being tried in which a group of practicing dentists are caring for all school children in their own offices, and are charging fees based on a predetermination of the family's ability to pay.

The clinics are established only where an active demand is made for the service by local dentists or some interested lay group. The first step in clinic organization is a meeting with, or a call on, all dentists of the section with whom clinic plans are formulated and outlined. Methods of limiting the work to eligible children are

discussed, every effort being made to limit the work to underprivileged children and to avoid invasion of any practitioner's clientele. While it must be admitted that mistakes have been made, the general consensus of opinion of the profession is that these errors have been few and unwitting.

The budget of the division of oral hygiene will permit but limited financial grants to each clinic. This amount is to be matched by some local group. These funds, plus fees collected from the children, finance the clinics. In a few cases, funds have been augmented by special grants from parent-teacher associations. The work is continued only as long as funds are available. Deficits in the state or local sponsoring group funds are carefully avoided.

The financial support arranged for, the clinic work begins under a clinician selected by the division and approved by local dentists and authorities. His first task is the inspection of all elementary grade children of the school. Originally, this procedure was termed "examination," but it has been definitely proved that much time and effort are wasted in making a thorough mouth examination (in a school). Its purposes are to apprise parents of the need of dental attention and to get the child to a dentist, when another examination, probably more thorough than any school examination can be, is imperative. Hence, an "inspection" that reveals the need of one single correction is as purposeful as a thorough charting of mouth defects.

The inspection made, parents are notified of the child's dental needs through typed forms furnished by the division. Children of parents able to afford dental care are given a notice advising a visit to their family dentist. Underprivileged children are sent a notice which also advises a visit to the family dentist but, in addition, offers school clinic care, which the parents may request. The classification of children into the different financial groups is made by some local person who is informed in regard to the financial status of local families.

Operative clinics are set up in the school or in convenient centers. Corrective work is limited to alloy and cemented fillings, simple extractions, prophylaxis and such treatments as are feasible under the rather adverse conditions in which the work is carried on. The accompanying table shows the total figures of clinic work for 1930, 1931 and 1932.

CLINIC WORK, 1930-1932

Year	Children Examined	Children Treated	Fillings Inserted	Teeth Extracted	Cleanings	Treatments	Total Operations
1930:	14,945	7,606	9,160	8,515	2,679	1,178	21,532
1931:	14,856	8,057	10,361	9,471	3,022	1,220	24,074
1932:	17,016	9,672	14,477	12,847	3,653	1,787	32,764

These figures show that as far as solving the problem of oral ill-health of the children of the state is concerned, the surface has been but scratched. But the enormity of the problem makes that "scratch" no mean accomplishment.

One feature of Maryland's clinic work must have especial mention; that is, the child healthmobile, an itinerant bus, which, for the past two summers (1931 and 1932), wended its way over six or seven Maryland counties bringing medical and dental inspection plus emergency dental treatment to thousands of preschool and school age children. I have

seen this healthmobile, with the portable dental equipment set up in church yards, woods, schoolyards or under the shade of a roadside tree. Here, truly, may "dentistry at the crossroads" be found, serving as an immediate boon to some of the underprivileged children in Maryland and as an educational factor in developing the interest of our citizens in mouth health.

THE EMERGENCY DENTAL RELIEF PROGRAM IN NEW YORK CITY

By HARRY J. STRUSSER*, D.D.S., New York City

DENTISTRY has again been recognized in the field of public health service. A plan has been put into operation in New York City which has a double purpose, that of furnishing dental relief to persons who are objects of charity, and of giving employment, at a reasonable wage, to dentists and hygienists whose earnings have been seriously lessened by the condition of the times. This excellent arrangement has been made possible through the alertness and sympathetic interest of the following persons: Mr. Harry Hopkins, who is chairman of the Temporary Emergency Relief Administration; Dr. Thomas Parron, Jr., who is the commissioner of health for the State of New York, and Dr. Shirley W. Wynne, who is the commissioner of health for the City of New York. Dr. Wynne, who had recently given material aid to dental health activities in New York City by fostering a widespread educational campaign, gladly welcomed the opportunity offered the city health department to render service to the public and the dental profession.

I need not spend much time on the subject of the urgent necessity for dental care among those persons who are accepting emergency relief. It is sufficient to say that in these days of financial stress the need is most acute. Many people who ordinarily obtained some dental attention in the past are at present financially unable to do so, and those who were unable to afford service in normal times are assuredly unable to do so now. Many members of the dental profession, owing to the unemployment situation, reduction in the salaries of their respective patients, or other contingencies, have been unable to keep busy. Many have lost numerous patients and are unable to meet the necessary expenses of home and office. These conditions have demonstrated the need for the twofold type of relief that is herewith presented.

The duty of mapping out a workable plan was given to the chief of the dental division of the city department of health, in cooperation with his assistants. Each new step in the program is previously sanctioned by the local dental profession.

Through the establishment of clinical facilities in addition to those already in existence and by the employment of dentists and dental hygienists on a part-

*Chief of Dental Division, Department of Health, New York City.

time basis, a more hopeful situation is evolving. One hundred and twenty dentists and dental hygienists are employed and properly supervised. They are rendering service to both child and adult patients. This being an emergency service, it is the ruling of the Temporary Emergency Relief Administration that this project be one of "work relief." Therefore, the dentists working under this plan are receiving $5 a period either morning, afternoon, or evening. Each period consists of from three to three and one-half hours. The dental hygienists are receiving $15 a week for part-time service. Their periods of part-time work may be morning, afternoon or evening.

We receive allotments monthly for the payment of salaries and for materials and supplies. These finances come from the Temporary Emergency Relief Administration through the state department of health. It is a direct grant from the state department of health to the dental division of the New York City Department of Health.

It is the intention in our program to give employment to as many persons as possible. Each dentist works three periods a week and this is carried out on a definite schedule. One group works on Monday, Wednesday and Friday morning, afternoon or evening. Another group works at similar periods on Tuesday, Thursday and Saturday. The schedule has also been arranged to increase the service facilities in the schools.

The type of work that is being done consists of amalgam, cement and synthetic fillings. Where there is 60 per cent or more in loss of chewing function, removable dentures are made. By arrangement with the New York University College of Dentistry, all cases of root-canal therapy are taken care of, and through an agreement with the dental division of the department of hospitals, all cases of extraction and surgery are handled.

All patients receiving this service are home relief cases or are referred to us by welfare agencies in the City of New York. Every case is investigated before the patient is sent to us.

In Manhattan Borough, in addition to increasing the children's service in the public school system, an adult clinic was established at the Heckscher Foundation. Through the courtesy and cooperation of Mr. August Heckscher, the dental clinic at the Heckscher Foundation was made available. This is a four-chair unit with x-ray, equipment available. The staff was chosen after investigation, and properly organized. This group was placed under the direct supervision of Dr. H. Shirley Dwyer, one of the department's supervisors, and the clinic has been functioning since December 5 for the benefit of patients referred by the Home Relief Bureau, Work Relief Bureau and the Allied Welfare Agencies.

In the Bronx Borough, a four-chair dental unit is now being organized with the cooperation of the Bronx Tuberculosis and Health Association, Allied Welfare Agencies and the Bronx Dental Society. The clinic began to function March 15 under the direct supervision of Dr. Herbert Ackerman, another of the department's supervisors. The children's service has been increased and the facilities of the department are being used to the utmost.

In Brooklyn Borough, the clinical facilities of the department's service for children has also been increased. Afternoon sessions have been started to give needy children the benefit of the services of dentists and dental hygienists. For adults, a four-chair dental unit has been

organized in cooperation with the welfare agencies of Brooklyn. The patients to be served will be supplied by these agencies. This clinic will be under the supervision of Dr. Aaron Apfel, another of the department's supervisors.

Thus, all available force is being utilized to render every possible assistance to people in need, and the dental division of the department of health has been able to fulfil its duty in the field of public health.

DO YOU HAVE SOME PRACTICAL IDEAS?

IN the April issue of THE JOURNAL, an article appeared under the title "Do You Have Some Practical Ideas?" Therein, several practical suggestions were offered which it was hoped would prove useful to our members in the problem of maintaining practice income and in rebuilding practices that had dwindled to the danger point. It was also suggested that members contribute other ideas of practical value which could be passed on through these columns. We again urge the contribution of suggestions or ideas for this purpose. There must be many individuals, here and there, who have solved certain of their economic difficulties, and their experiences may be of great value to another member in meeting his problems. Here is an opportunity to be of real service to a professional brother in distress. The practical idea may seem trivial to its originator, but it might prove of inestimable assistance to someone else. Mail all suggestions to the Bureau of Public Relations, American Dental Association, 212 East Superior St., Chicago, Ill.

An idea was received the other day which is worth consideration. It applies to that practitioner who has not awakened to the advisability and economy of doing certain of his own laboratory work. Patronizing the commercial laboratory has become a fixed habit with some members of the profession. There are numerous dentists who even go so far as to have their inlay casting done by a commercial laboratory.

Many dollars could be saved if the practitioner would use spare time in doing some of his own laboratory work. It may take a little practice to get back the old skill in soldering or in certain other phases of laboratory technic, but it will be time well spent. Certainly, it will aid in eliminating nonproductive time, at least in part. In boom days, the practitioner who spent most of his working hours at the chair and sent all of his laboratory work to a commercial laboratory was probably making a better income under that arrangement. He was completing more cases and the productivity of his chair hours was greater than that of a proportionate number of laboratory hours devoted to soldering bridges or doing some other type of laboratory work, but he was making his chair hours pay the cost of those laboratory fees; which can be done with profit as long as the chair hours are profitably filled. Diminish those chair hours to any great degree and the commercial laboratory service becomes an extravagance. To idle around the office while some commercial laboratory is constructing a bridge that could just as well be made in the office laboratory is certainly not an economy.

It is appreciated that there are some

logical exceptions that may be taken to the foregoing idea. It is not necessary to point these out because every practitioner knows his own limitations as far as circumstances, ability, and laboratory equipment are concerned. Taking those limitations into consideration, and at the same time appreciating the possibility of the individual's improving his laboratory technic, there is assuredly economical justification for the suggestion.

A very inspiring letter was received the other day from a member who had read the previous article.[1] This letter is so wholesome and contains so much common sense that we are printing it in its entirety:

Some fifteen years ago, I bought an office and some equipment from a dentist, who, after a year's struggle, could not pay his rent. The office was situated in the middle of a block on West Sixty-Third Street in Chicago. I had practically no friend or acquaintance in the neighborhood, nor did I belong to any lodge or church in the vicinity of the office. In that respect, I have never formed a friendship with the idea of cultivating a prospective patient. The few friend-patients I have are usually economically unprofitable. Some of the few patients of my predecessor who came to my office left in disgust because I would not extract a tooth for fifty cents or clean their teeth for a dollar.

I had to start building a practice. My assets were a D.D.S. degree from Northwestern University Dental School, a wife, a baby and a debt of $2,500.

The drop in real estate values and the collapse of the Bain banks have left me penniless and in debt. Still, I manage to pay my bills on time. We are five in the family and are helping two other families. How do I do it?

1. I am a member of the American Dental Association. I attend all important meetings, conventions and clinics, and have taken at least one study course each year since graduation.

2. I read THE JOURNAL and the *Dental Cosmos*, and I am making good use of the facilities of the Library Bureau of the American Dental Association. Much of its service is free to Association members.

3. I do not hesitate to "sponge" on the knowledge of my fellow members whenever I am confronted with a problem, and I have always found them willing to give me of their superior knowledge and experience.

4. I spend no more than forty-four hours a week in my office, and I try to be just as punctual about leaving as I am in arriving. This makes work a pleasure instead of a burden.

5. I work by appointment. The patient in the chair has my undivided attention. The patient receives a full explanation as to why he must have a tooth extracted or saved. He is told why he should have an inlay and not a crown or an amalgam filling. A great majority of the patients understand and appreciate that information. Once the patient knows his needs, he is willing to pay for them. If he does not possess the necessary funds at the time, he will return later.

6. I employ an assistant. This gives me time to (*a*) give a *thorough* examination to every patient and (*b*) educate the patient to the need of having the necessary work done.

I often find much work to be done on patients previously dismissed by a dentist who had overlooked conditions requiring attention. Why should we constantly look for new patients and permit the old ones to go with work unfinished?

The assistant, among other things, makes it possible for me to attempt the more difficult extraction in which assistance is indispensable. Also, by taking care of various minor duties, she enables me to have more time to improve my technical and business methods.

7. I make it a point to serve *all* the needs of my patients at my office, including radiography, removal of impacted mandibular third molars and orthodontia.

8. In 1932, I treated nearly 100 individual children. Saturday morning and week days from 3:30 to 5:00 are almost exclusively devoted to the care of child patients. Many children come to me because I treated their mothers years before. I also have many parents who come in after I have taken care of their children.

9. Cheap laboratories and cheap supplies are poor economy. I tried them in my earlier days and gave them up. The dentist who is looking for the cheapest in such things is

1. J.A.D.A., 20:732 (April) 1933.

akin to the patient who goes to the cheapest dentist.

10. I always get my 10 per cent discount from the laboratory for cash and 2 per cent from the supply house. I often obtain gold at the price paid by the laboratories. I do sterilizing by gas in a $1.25 sterilizer. It is quicker and cheaper. I erase the names and dates from old celluloid film holders and use the holders over again. I own my towels and get them washed for 1 cent apiece. I cast several inlays in one ring to save time and investment material.

11. I do not economize on burs, mounted stones, laundry, shaving, manicuring, shoe polish or reprints of appropriate dental health talks.

12. Not a single instrument is allowed to remain on the bracket table when a patient is dismissed. Each patient starts with a clean set of instruments. I make it a habit to dry my hands in front of the patient.

13. During the past year, I did considerable work for nothing or next to nothing, but 75 per cent of my patients were quoted and paid the same prices that they paid in more prosperous years. When they grumbled, I explained that they really got a bargain in previous years. Incidentally, I sincerely believe so myself.

CURRENT LITERATURE

Calcium Need and Calcium Utilization (Alice R. Bernheim, J.A.M.A., April 1, 1933, p. 1001): Sherman is quoted as calling attention to calcium deficiency of the average American dietary in 1911, and, after twenty years, as stating that probably a larger proportion of the ordinary dietaries can be improved by enrichment in calcium than by enrichment in any one chemical element. This is surprising, but the probable reason is given as the prevailing opinion that "bread is the staff of life," and the "mixed meal" represents a sufficient diet. Calcium supply is discussed, the commonly supposed calcium supplying food and how calcium is lost in cooking, particularly the cooking of vegetables containing meager amounts of the substance. Bernheim contends that the majority of American cooks, in spite of advice, cook as they always have cooked. Calcium is absorbed through the small intestine and its absorptive power is determined by (1) the hydrogen ion concentration within the intestine and (2) the relative proportion of other substances in the diet. Solubility is essential in an acid medium. Fats and excessive amounts of phosphorus interfere with absorption. The influence of vitamin D on absorption is questioned. The failure of much oral therapy is due to the administration of calcium at times when intestinal alkalinity is highest and it is therefore absorbed insufficiently or not at all. A high calcium diet implies from 0.7 to 1.0 gm. of calcium, which may be obtained from one quart of milk or one-fourth pound of cheese. General health is improved and recovery from disease aided when the optimum calcium supply and utilization are assured. Utilization of calcium is ineffectual even with a sufficient intake unless the controlling factors are adequate. N.G.T.

Recent Research on Dental Caries and Its Prevention (J. Sim Wallace, New Zealand D. J., January, 1933, p. 83): Dr. Wallace quotes in his first paragraph from bits of research done in Hawaii. After the first quotation, he says: "I am afraid, too, that the theory misled them [the authors]. They, of course, knew that, by many, sugar was considered the chief cause of caries." This becomes his thesis in addressing himself to others. After the second quotation, he declares, "When, however, reliable information can be obtained, rapid destruction of teeth can invariably be traced to sugar of one kind or another, or a mixture of sugary or starchy foods of an easily fermentable nature which lodge more especially about the retention areas of the teeth." Likewise, he assays a third and rejoins with: "It is stated that sugar is hardly ever used." This statement, together with a consideration of the staple articles of diet plus green vegetables, turnips, cabbages, etc., at once gives the clue to the relative freedom not only from caries but also from pyorrhea and irregularities. Apropos of the absence of vitamin D as a cause of hypoplasia, he writes: "It might perhaps be noted that in recent years research workers have been distracted and misled by animal experiments

claiming to show that vitamin D deficiency was the cause of this, that or the other theory, when, indeed, the actual cause may have been intercurrent disease." Regarding another series of investigations, he comments that the workers reduce the incidence of caries by a diet he had employed in which no consideration whatever was given to vitamin D. He quotes to support his contention the fact that the Mellanby theory of the cause of caries has long since been discarded by a majority of thinking men in the dental and medical professions. Concerning enamel as the first victim of caries, he explains that "the sensational idea was brought forward that there was metabolic activity in enamel!" In answer to this, he argues that there is no evidence of circulation of lymph in enamel; nor are there corpuscles in the so-called lymph supposedly in enamel, and lymph devoid of corpuscles is no more alive than keratin. In conclusion, he quotes Professor Shaw, "Is there any hope of eliminating caries?" There is, and he tells how it may be accomplished. To the answer, he adds that eminent students knew it years ago; Parmly more than 100 years ago; almost as long ago, Robertson; fifty years ago, Miller; and notwithstanding the blinding blizzard of vitamins which obscured almost every landmark that had been reliably charted decades of years ago. N. G .T.

Psychology Applied to School Dentistry (Edward Samson, Brit. D. J., Feb. 15, 1933, p. 159): Dr. Samson sounds a warning regarding the false conception of psychology that has become common since and because of the war—"no conception at all but merely a mass of misconception." This is largely due to psycho-analytical novels by certain authors who perhaps know their subject but by a greater number who do not. A new jargon has developed without discretion or understanding. The author contends that a young child is essentially a reflex organism responding to immediate impressions. It is free and animal in its physiology and almost as simple in its psychology. It comes as a highly sensitized machine ready to respond to any unusual stimulus. It reasons in positive and negative; it trusts or distrusts; it likes or dislikes. It must understand what is to be done and that it is going to be done. The straightforward, straight thinking mechanism of the child is open to suggestions and by correct suggestion is easily controlled. Therefore, the child must receive quieting, soothing impressions which establish confidence in the dentist and in himself. The fear caused by the new surroundings makes the child seek its customary parental protection; therefore, the parents must be kept from the room. The dentist must judge a child's feelings more by its behavior than by its spoken words. He must be truthful, self-controlled. His knowledge of the child mind must be based on a knowledge of general psychology and detailed knowledge of child psychology. If he understood children as he usually does adults, no more patience would be required for one than for the other. The psychologic condition of the dentist himself is just as vital to the success of the work as is his knowledge of the child mind. N. G. T.

Some Reflections on the Nature of Odontomes (A. T. Pitts, Brit. D. J., March, 1, 1933, p. 217): There are few full-dress discussions of these tumors as a whole. Pitts quotes and praises works on odontomes by Bland-Sutton, Gabell, James and Payne, Colyer and Sprawson. Knowledge has been accumulating to such an extent as to make possible a grading of these growths to show their affinities more clearly. Pitts criticizes the definitions of the foregoing and launches a new one: "An odontome is an abnormal formation of tissues homologous with the dental tissues in their developmental, preeruptive or posteruptive stages, which occurs usually in the region of the jaws, but may also be found in regions not normally associated with tooth formation." Those developed in the jaws, he terms "gnathic odontomes"; those found elsewhere, "teratomatous odontomes." Pitts would grade composite odontomes in an ascending order of complexity. He then presents and discusses the special points which require investigation: (1) site of origin; (2) nature of the differentiation in the course of growth; (3) conditions limiting growth; (4) relationship of various forms of odontomes to one another; (5) preeruptive and posteruptive phases of odontomes, and (6) quantitative and qualitative evolution of odontomes. N. G. T.

The Dentist and the Pharmacist's Opportunity for Professional Service (George C. Schick, J. A. Pharm. A., February, 1933, pp. 137-143): Schick uses the dentist to illustrate the opportunity pharmacists have for the development of the professional aspect of his service. There is no professional group today more eager to be told the truth about drugs and preparations which have real merit than dentists. The best minds in the profession are pointing out the advantages of using drugs

which the medical profession have proved as standard recognized therapeutic agents. The American Dental Association is encouraging at every opportunity the use of official drugs. There are 67,000 dentists in the United States who prescribe drugs in a limited way. There are no statistics available which show how many of these dentists dispense their own prescriptions. The author feels rather certain that the number is small. Many dentists prescribe by word of mouth, telling their patients to get a bottle of this or a box of that at some drug store on the way home. Almost always, too, the dentist gives them a sample of some kind to relieve pain after extraction or in treatment of some oral condition. These samples are usually left by salesmen of proprietary dental remedies. This method of advertising, employed by dental proprietary manufacturers who sell products with false claims, is not only exploiting the dental profession, but also is fostering the habit of self-medication, a practice which is fair neither to the dentist nor to his patient. Schick ends his appeal for dental patronage with a list of formulas pharmacists may prepare and dentists prescribe in accord with the patient's need and based on a skilful diagnosis.

Galvanic Burns of the Tongue (Hollander, Schonfield and Fisher, J.A.M.A., April 1, 1933): A case report is presented that is said to be a clear-cut demonstration of galvanic currents generated in the mouth by metals. The tip of the tongue presented six faceted lesions. The whole tongue was swollen and reddened, but each lesion was distinct. Each was covered with white discoloration, tissues in the affected area being thick and rough and firmly attached. The facets rested against gold crowns and pontics with gold backs. The metal was 24 and 18 carat. A metallic taste and a burning sensation was produced. A diagnosis of leukoplakia linguae and chronic glossitis was made. On removal of the crowns, recovery ensued. Histologic changes had taken place in superficial and deeper layers of the mucosa. These were a hyperkeratosis, an intense acanthosis and lymphocytic infiltration.

N. G. T.

Foreign Literature

An Unusual Case of Jaw Fracture (Max Melchior, Tandlægebladet, Copenhagen, Denmark, January, 1933, p. 21): Dr. Melchior is of the opinion that fractures of the maxilla are much more common than most textbooks lead one to believe. In his experience, incomplete fractures are very common, although they are hard to demonstrate roentgenographically. The fact that the fragments are usually in apposition and that the soft tissue lesions are insignificant are other reasons why fractures of the maxilla are considered rare. His patient had for two years after an auto accident been under the care of nine different physicians for a series of complaints: severe pain in the left colon and in the left side of the face, a feeling of heaviness in the head, deafness in the left ear, constant ear noises, partial paralysis of the left eyelid and impaired memory. Treatment did not help and statements of the men in charge of the case varied to a great degree. A nerve specialist classed the patient as plainly a neurotic. Examination of the patient's mouth revealed a little lump the size of a pea in the area of the upper left second bicuspid (the upper left third molar was the only tooth present) from which ran a low sharp bony ridge superiorly and posteriorly. This protuberance and ridge was removed and the patient became entirely well and stayed well. Dr. Melchior's diagnosis was: reflex neurosis caused by pressure on the ends of the second branch of the trigeminal nerve by the sharp ridge of bone left when a fracture of the maxilla unnoticed at the time of the accident healed. He adds that the fifth nerve, owing to its long course in bone canals and its connection with no less than four ganglia, must be considered predisposed to neuralgia. E. G. Jacobson.

Balanced Occlusion and Its Importance in the Treatment of Marginal Paradentitis (Gosta Lindblom, Tandlægebladet, Copenhagen, Denmark, February, 1933, p. 71): The author presents models, roentgenograms, and case histories to show how, in some cases, he succeeded in curing paradental lesions by cusp grinding (his Group 1). His Group 2 involves cases in which the height of the bite is normal, but prosthetic restorations were necessary to restore normal occlusion. Group 3 involves bite raising cases. He is of the opinion that the cases in Group 1 have been generally overlooked and that a little grinding in time will, under certain conditions, save the bite from destruction. E. G. J.

Do Certain Fungi Play a Part in the Formation of Dental Calculus? (Olaf Grythe, Den Norske Tannlægeforenings Tidende, January, 1933, p. 1): The author discusses the different theories of dental calculus formation, giving a fairly detailed explanation of the theory of Professor Nasland of Up-

sala, whose view his own work largely substantiates. Certain types of leptotrix and actinomyces (the author thinks these might be different formations of the same organism) form the stroma for the calculus, and by their ability to lower the hydrogen ion concentration of saliva, they also cause the precipitation of the calcium in the saliva. The illustrations show different forms of the same organism varying from short rods to ray fungi grown on culture mediums with a p_H varying from 5 to 8. Even in test tubes, the fungi have the ability to lower the p_H of the medium, but only if no carbohydrates that can be fermented are present. This, the author believes, is the reason for the calculus formation at the opening of the salivary duct: the saliva is here free from carbohydrates and the mycelium can cause the precipitation of calcium. —E. G. J.

A Case of Osteoma in the Maxilla and Some Cases of Circumscribed Sclerotic Smaller Foci in Both Jaws (Johan Rygge, Den Norske Tannlægeforenings Tidende, February, 1933, p. 61: Dr. Rygge gives a brief discussion of the osteoma presenting one case from his practice. The patient had an osteoma in the region of the right tuberosity causing head pain, which disappeared on the removal of the tumor. The author comes to no conclusion as to the origin of the tumor. He agrees with Riha's views *(Ztschr. f. Stomatologie, 1926)* that the sclerotic areas one often finds in either jaw are not neoplastic but just condensing osteitis. He is of the opinion that these sclerotic foci do not commonly cause the patient any discomfort and should not be removed. E. G. J.

Development of Postoperative Pain Following the Extraction of Lower Third Molars (I. Schollähn, Deutsche Monatschr. f. Zahnheilk., Vol. 50, 1932, pp. 54-67: Postoperative pain following extraction is explainable on the basis of (1) changes in the lymph vessel apparatus; (2) injury of the nerves, and (3) inflammation of the bone. The causes of postoperative pain are wound infection, trauma (stretching or fracture of the alveolar wall), the presence of persisting bony margins of the interradicular septum or alveolar crest, contraction of the gingivae from scar tissue, chronic or acute suppurative periodontitis, unremoved granuloma (residual), anisotonic condition of local anesthetics and excessive administration of epinephrine. The extraction of the lower third molar is associated with subsequent pain with especial frequence. This is explainable, in addition to the general causes, by the following special considerations: 1. The acute or latent inflammation of the lymph glands that is found in difficult dentition is aggravated. 2. Because of the close proximity of the third molar to the mandibular canal, maceration or even tearing of the inferior alveolar nerve may occur. 3. Injury of the lingual nerve may occur. 4. Osteitis may develop through maceration of blood vessels resulting from difficult luxation, with subsequent infection of the bony tissue, which is injured through disturbance of the blood supply. ISAAC SCHOUR.

Removing the Operculum by Diathermy (O. A. Lourides, Greek D. Rev., March, 1933): Lourides describes the eruption of lower third molars which terminate with deep gingival crevices and residual operculum with their customary sequelae of pain, swelling, trismus, spreading into the peritonsillar tissue and the attendant danger. To remove the operculum, he advocates diathermy because the operation is quickly done, is bloodless and painless and has a salutary effect on the nervous system of the patient. He states that it stops acute pain, destroys the tissue over the tooth completely and has a salutary effect on the surrounding tissue and renders them sterile, and that the wound heals readily. He describes the technic in detail. The resultant scar tissue may either be removed instrumentally or allowed to slough off of its own accord. The operation results in permanent relief. T. D. GALLANOS.

MISCELLANY

CORRESPONDENCE

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION "VERSUS" PULPLESS TEETH

To the Editor: A recent editorial[1] entitled "Roentgenographically Negative Pulpless Teeth as Foci of Infection" deserves critical study, and perhaps some questioning.

In the first place, if it were not unseemly, one might inquire just where the "shaft of the tooth," mentioned in the article, is located. The long bones are provided with a shaft, but the teeth have roots, which are defined in both medical and dental dictionaries, and the term root is applicable also even in a roentgenographic diagnosis. However, this is a quibble rather than a comment.

At least two statements suggest a need for elucidation. The editorial in question mentions the fact that according to statistics, from 80 to 90 per cent of the mouths of adults contain teeth with filled root canals and that an average of 69.5 per cent of these pulpless teeth show roentgenographic evidence of periapical infection. The first question which arises in the mind of the dentist regards the definition of a filled canal. Was the canal properly filled to the apex, or was only the gingival half filled (partly) and the remainder unfilled? A canal incompletely filled may certainly be as great a menace as one which has never been treated. I would suggest that the statistics which are quoted do not represent the true facts for the reason that clinical experience is at variance with the figures.

If pulpless teeth which have properly filled canals were so serious a menace as this editorial seems to indicate, it is a marvel that the 90 per cent of adults having teeth thus filled are still alive. It may also be pointed out that the data were secured, not from a cross-section of the general practice of a dentist, but from persons who already showed signs of disease.

Mention is made also of the electric test for pulp vitality. This test has been conceded by many to be practically worthless, for the reason that the current, instead of passing from the outside of the tooth to the pulp by way of enamel, dentin or filling, may frequently short circuit down the side of the root and bring a response from the nerve fibers in the cemental membrane. Thus, a tooth with a dead pulp may frequently respond in the same manner as a tooth with a live pulp. This in itself is a serious drawback to the method and vitiates any data so secured. Indeed, the diagnosis of pulp vitality may confuse even the experienced practitioner, for the reason that, in multirooted teeth, one root canal may contain vital pulp filaments which respond to test and the other roots contain necrotic tissue which does not respond.

Those who are not entirely content with certain of the statements made by the supporters of the now greatly debilitated theory of focal infection can point to a great number of cases that have showed no improvement, even though extraction of all teeth had been carried out.

It is curious, but true, that the tooth many times is regarded as the primary focus. It might just as well be the secondary focus, either active or inactive. If experimenters expect to find "control teeth" free from bacteria, they have yet to explain why the apices of teeth should present such a condition not found in any other part of the body; namely, an entire absence of infection, or of bacterial products.

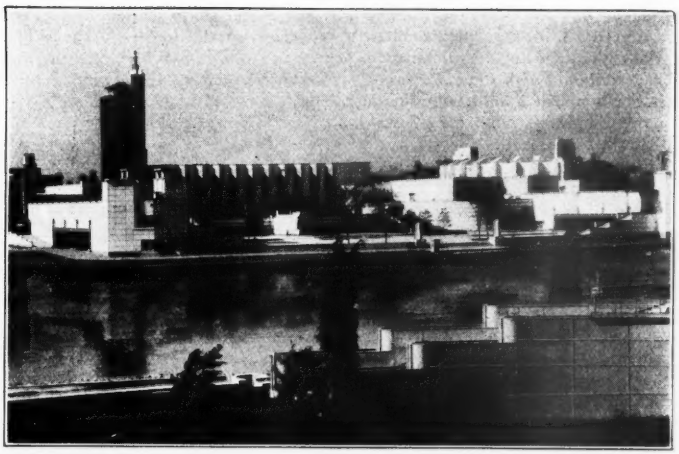
Let us have both sides, and the truth at any cost, rather than comments which are open to question and which are in direct contradiction to clinical experience.

JOHN ALBERT MARSHALL,
University of California,
San Francisco.

1. J. A. M. A., 100:974 (March 25) 1933.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS

The Second District Dental Society of New York has for several years been working for the advancement of oral diagnosis, principally



Where the magic of modern science will be portrayed this year in Chicago, the Hall of Science of A Century of Progress. This huge structure, 700 by 400 feet, is shaped like a U, and encloses on three sides a court capable of accommodating 80,000 persons. At one corner rises a 176-foot tower equipped with a carillon. The building faces a beautiful lagoon, an island and, beyond, Lake Michigan. At night it has the appearance of a brilliantly illuminated metal and glass creation, rising from colored terraces. The Hall of Science was dedicated, June 1, 1932. Exactly one year later, the science exhibits will be officially started by the light of the Star Arcturus, focused by means of a telescope upon a photoelectric cell. As Arcturus is forty light years distant, the impulse that starts the science exhibits in 1933 left Arcturus in 1893, at the time of Chicago's first World's Fair.

under the leadership of Orville S. Long, of New York City. As an extension of these efforts, a call was issued to those with whom Dr. Long had been in correspondence to meet in New York City in March, 1932, for the purpose of considering the formation of an association for the United States and Canada. The decision of this meeting was than an organization should be formed at the time of the American Dental Association meeting in Buffalo, in order that all parts of the United States and Canada might be represented.

Notice was sent to 300 dentists and physicians in the United States and Canada who were known to be interested in oral diagnosis, regarding the meeting to be held in Buffalo. Announcement of the meeting was also published in THE JOURNAL.

At this meeting, several papers dealing with problems in diagnosis were read. After a general discussion, is was decided to organize the American Association for the Advancement of Oral Diagnosis, the organization not to become affiliated as a section of the American Dental Association for the present. Meetings are to be held in conjunction with those of the American Dental Association.

A constitution was proposed and the following officers were elected: Orville S. Long, New York, president; R. Gordon McLean, Toronto, vice-president, and Daniel E. Ziskin, New York, secretary-treasurer.

Six men, besides the officers, were elected to form an executive committee. These were: J. L. Appleton, Jr., Philadelphia; Thomas J. Cook, Philadelphia; Frank A. Cushman, Boston; Harold J. Leonard, New York; Sterling V. Mead, Washington, and William B. Ryder, San Francisco.

The purpose of this association is the dissemination of knowledge and the development of interest in oral diagnosis among members of the dental and medical professions. At the present time, the following committees are functioning: Committee on Philosophy and Content of Oral Diagnosis, Frank A. Cushman, chairman; Committee on Charge Forms, R. Gordon McLean, chairman; Committee on

Education, Undergraduate and Postgraduate, Harold J. Leonard, chairman, and Committee on Publications, William B. Ryder, chairman.

Those properly qualified are invited to apply for membership. All applications should be sent to the Secretary, Daniel E. Ziskin, 630 West 168th Street, New York City.

HEALTH EDUCATION CONFERENCE

The American Child Health Association will hold its seventh health education conference in Ann Arbor, Mich., June 20-24, at the invitation of the University of Michigan Summer Session. As previously, the conduct of this conference will be characterized by the cooperative work of all members, and the discussions will center on practical problems in the school health program in teacher, secondary and elementary education. Problems will be selected which have a common vital interest to all agencies in any way connected with school health activities.

The future of health education calls for straight thinking and courageous action. At this time, when, in the interest of the entire social group, each aspect of education must be reevaluated and reconstructed in its relationship to the total needs of both society and the individual, health education must concentrate on its most productive lines of action. Then the future of health education will be one of liberation and progress, not of limitation. Essential to this is a recognition of mutual relationships on the part of all participating in the school health program and a unity of understanding of those basic policies and principles which may help to guide wisely the developing health education programs of tomorrow.

The purpose of this conference is, therefore, to (1) chart some significant trends and characteristics in the growth of present school health programs; (2) clarify a few definite problems of basic significance which apparently tend to retard the future growth of programs, and, in relation to these problems; (3) formulate, through group thinking, sound principles and unified policies which will be of practical constructive value in liberating the potentialities of school health programs.

For further information in regard to this conference, write to Miss Anne Whitney, director of educational service, American Chilo Health Association, 450 Seventh Avenue, New York City.

NEWS

Deaths

Bivens, S. B., Charlotte, N. C.; Southern Dental College, 1915; died, January 18; aged 42.

Cooley, F. D., Chicago, Ill.; Northwestern University Dental School, 1900; died, February 20; aged 61.

Cooper, Robert, S., Winterset, Iowa; Des Moines College of Dental Surgery, 1901; died, January 19, of heart disease.

Edge, C. E., Rocky Mount, N. C.; Baltimore College of Dental Surgery, 1912; died, January 16; aged 42.

Freile, James H., Ridgefield, N. J.; New York College of Dentistry, 1902; died, February 8.

Gorman, Thomas F., Chicago, Ill.; Chicago College of Dental Surgery, 1898; died recently, from skull fracture suffered in a fall.

Kellogg, L. F., Marshalltown, Iowa; Temple University School of Dentistry, 1885; died suddenly January 9.

Kerr, William H., Weehawken, N. J.; New York College of Dentistry, 1909; died of pneumonia, February 11.

Krog, Robert W., Los Angeles, Calif.; University of Illinois, College of Dentistry, 1905; died of pneumonia, April 8; aged 50.

Mauk, Harold J., Monticello, Ill.; died, April 12; aged 33.

Megginson, W. Merton, Toledo, Ohio; Western Reserve University, School of Dentistry, 1897; died, February 6, of apoplexy. aged 62.

Porges, A. J., Chicago, Ill.; Chicago College of Dental Surgery, 1897; died March 29; aged 60.

Tidball, Jesse R., Everett, Wash.; North Pacific College of Oregon, School of Dentistry; died, January 27.

Welch, T. M., Waupun, Wis.; Chicago College of Dental Surgery, 1889; died January 26; aged 65.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association in conjunction with the Chicago Centennial Dental Congress, Chicago, Ill., August 7-12.

American Academy of Periodontology, Chicago, August 3-5.

American Society of Oral Surgeons and Exodontists, Chicago, August 4-5.

Alumni Society of Philadelphia Dental College and Dental School of Temple University, Philadelphia, May 1.

Association of American Women Dentists, Chicago, Ill., August 7.

Dental Alumni Association of American University of Beirut, Syria, June.

Eastern Association of Graduates of Angle School of Orthodontia, New York City, May 1-2.

Eastern Society of Dental Anesthetists, New York City, May 19.

Fédération Dentaire Internationale, Edinburgh, July 22-27.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Society of Orthodontists, Hot Springs, Va., November 13-15.

National Association of Dental Examiners, Chicago, August 7.

Ontario Dental Association, Toronto, May 15-18.

American Dental Assistants Association, Chicago, August 7-12.

American Dental Hygienists' Association, Chicago, August 7-12.

Dental Hygienists Association of State of New York, Syracuse, May 11-13.

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

STATE SOCIETIES

May

Illinois, at Peoria (9-11).
Indiana, at Indianapolis (15-17).
Iowa, at Des Moines (2-4).
Maryland, at Baltimore (1-4).
Massachusetts, at Boston (1-4).
Missouri, at St. Louis (15-17).
Nebraska, at Omaha (15-18).
New York, at Syracuse (11-13).
North Dakota, at Valley City (16-17).
Pennsylvania, at Philadelphia (2-4).
South Carolina, at Columbus (22-23).
Texas, at San Antonio (9-11).
Vermont, at Burlington (17-19).
West Virginia, at Charleston (15-17).

June

Arkansas, at Little Rock (5-7).
California (Southern), at Los Angeles (5-7).
Colorado, at Colorado Springs (19-21).
Georgia, at Savannah (12-14).
Maine, at Rangeley Lake (22-24).
Mississippi, at Gulfport (15-17).
Nevada, at Reno (3).
New Hampshire, at North Conway (1-2).
North Carolina, at Chapel Hill (6-8).
Oregon, at Portland (21-24).
South Dakota, at Watertown (26-27).
Utah, at Ogden (1-3).
Washington, at Yakima (June 30-July 2).
Wyoming, at Laramie (June 30-July 1).

STATE BOARD OF DENTAL EXAMINERS

Alabama, at Birmingham, June 26. E. W. Patton, Secretary, Comer Bldg., Birmingham.

Arkansas, at Little Rock, June 19-22. Clarence W. Koch, Secretary, Donaghey Bldg., Little Rock.

California, at San Francisco, May 22, and Los Angeles, June 19. K. I. Nesbitt, Secretary, 450 McAllister St., San Francisco.

Colorado, at Denver, June 6-10. Zenas T. Roberts, Secretary, Metropolitan Bldg., Denver, Colo.

Connecticut, at Hartford, June 28-July 1. Almond J. Cutting, Recorder, Southington.

Delaware, at Wilmington, June 21-22. W. S. P. Combs, Secretary, Middletown.

Florida, at Jacksonville, June 21. R. P. Taylor, Secretary, Jacksonville.

Georgia, June 1. R. C. Coleman, Secretary, Atlanta.

Indiana, at Indianapolis, June 14. J. M. Hale, Secretary, Mt. Vernon.

Iowa, at Iowa City, May 29-June 1. Hardy F. Pool, Secretary, Mason City.

Kentucky, at Louisville, June 7-10. Robert L. Sprau, Secretary, 970 Baxter Bldg., Louisville.

Louisiana, at New Orleans, June 12. Joseph L. Webre, Secretary, Audubon Bldg., New Orleans.

Maine, at Augusta, June 26-28. Alton H. Swett, Secretary, 192 State St., Portland.

Massachusetts, at Boston, June 13-16. W. Henry Grant, Secretary, State House, Boston.

Minnesota, at Minneapolis, June 16-24. Walter H. Smith, Secretary, 2337 Central Ave., Minneapolis.

Mississippi, at Jackson, June 20-23. T. Ford Leggett, Secretary, Laurel.

Missouri, at St. Louis, June 7-10. George E. Haigh, Secretary, Central Missouri Trust Bldg., Jefferson City.

Nebraska, at Omaha and Lincoln, June 12-17. Mrs. Clark Perkins, Director, Bureau of Examining Boards, Lincoln.

New Jersey, at Trenton, June 26-July 1. John C. Forsyth, Secretary, 148 W. State St., Trenton.

North Dakota, at Fargo, July 11-14. R. E. Percy, Secretary, Mandan.

Oklahoma, at Oklahoma City, June 19-22. E. E. Sanger, Secretary, Yukon.

Pennsylvania, at Philadelphia and Pittsburgh, June 21-24. W. A. McCready, Secretary, Highland Bldg., Pittsburgh.

Rhode Island, at Providence, June 27-29. Albert S. Midgley, Union Trust Bldg., Providence.

South Carolina, at Columbia, June 13. David Aiken, Secretary, Winnsboro Bank Bldg., Winnsboro.

South Dakota, at Sioux Falls, June 26-28. John J. Berry, Secretary, Deadwood.

Tennessee, at Memphis, June 12. F. W. Meacham, Hamilton National Bank Bldg., Chattanooga.

Texas, at Dallas, June 12-15. A. L. Nygard, Secretary, Medical Arts Bldg., Dallas.

Vermont, at Montpelier, June 26-28. H. B. Small, Secretary, Burlington.

Virginia, at Richmond, June 13. John M. Hughes, Secretary, Medical Arts Building, Richmond.

Wisconsin, at Milwaukee, June 12-16. S. Donovan, Secretary, Tomah.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The Delaware State Board of Dental Examiners will hold its next regular examination for the purpose of licensing dentists and dental hygienists to practice in Delaware, June 21-22, at the Delaware Hospital, Wilmington. Applications must be on file in the secretary's office fourteen days before the date of examination. For further information, address

W. S. P. COMBS, *Secretary,*
Middletown.

LOUISIANA STATE BOARD OF DENTISTRY

The next examination of applicants to practice dentistry in Louisiana will be held at Loyola University, Dental Department, New Orleans, the week of June 12. Applications properly executed before a notary, together with college diploma and fee of $25 must be filed with the secretary at least ten days prior to date of examination.

JOSEPH L. WEBRE, *Secretary,*
Audubon Bldg.,
New Orleans

STATE OF MINNESOTA BOARD OF DENTAL EXAMINERS

The next meeting of the Minnesota State Board of Dental Examiners will be held at the University of Minnesota, June 16-24 inclusive. For application and further information, address

WALTER H. SMITH, *Secretary,*
2337 Central Ave.,
Minneapolis

MISSOURI STATE DENTAL BOARD

The next examination of the Missouri State Dental Board will be held at the Washington University, St. Louis, June 7-10. All applications must be in the hands of the secretary at least ten days before the date of examination. For information, address

GEORGE E. HAIGH, *Secretary,*
Central Missouri Trust Bldg.,
Jefferson City

STATE OF NEBRASKA BUREAU OF EXAMINING BOARDS

The next dental examination in Nebraska will be given June 12-17 inclusive. The first

three days, a practical examination will be held at the University College of Dentistry, Omaha. The last three days, a written examination will be given at the State House, Lincoln.

MRS. CLARK PERKINS, *Director,*
Lincoln

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the North Dakota State Board of Dental Examiners will be held July 11-14 inclusive, at the Gardner Hotel, Fargo. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to date of examination. Address all communications for further particulars to R. E. PERCY, *Secretary,*
Mandan

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the South Carolina Board of Dental Examiners for examination of applicants for license will be held in the Medical Building, Columbia, June 13.

DAVID AIKEN, *Secretary,*
Winnsboro Bank Bldg.,
Winnsboro

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the South Dakota State Board of Dental Examiners will be held at the Carpenter Hotel, Sioux Falls, June 26-28. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to date of examination.

JOHN J. BERRY, *Secretary,*
Deadwood

TENNESSEE BOARD OF DENTAL EXAMINERS

The Tennessee Board of Dental Examiners will meet at 9 a. m., June 12, in the Dental Department of the University of Tennessee, Memphis, for the purpose of examining all applicants who present credentials acceptable to the board. Hygienists will also be examined. Credentials must be presented for examination by the entire board. Applications should be in the hands of the secretary five days before the meeting. For application blanks and clinical requirements, address

F. W. MEACHAM, *Secretary,*
Hamilton National Bank Bldg.,
Chattanooga

ASSOCIATION OF AMERICAN WOMEN DENTISTS

The twelfth annual meeting of the Association of American Women Dentists will be held at the Stevens Hotel, Chicago, August 7. An invitation is extended to woman dentists.

GENEVA E. GROTH, *Chairman,*
Publicity Committee,
Medical Arts Bldg.,
Philadelphia, Pa.

SOUTHERN SOCIETY OF ORTHODONTISTS

The thirteenth annual meeting of the Southern Society of Orthodontists will be held at the Homestead, Hot Springs, Va., November 13-15. Ethical members of the dental and medical professions are invited to attend.

WILLIAM P. WOOD, JR., *Secretary,*
442 W. Lafayette St.,
Tampa, Fla.

EASTERN SOCIETY OF DENTAL ANESTHETISTS

The May meeting of the Eastern Society of Dental Anesthetists will be held May 19 at the Hotel Westover, New York City. Dinner at 7:30 p. m., lecture at 8:30. For reservations, call

SAMUEL L. BINDER, *Secretary,*
624 Bergenline Ave.,
West New York, N. J.

CLASS OF 1923, COLLEGE OF ORAL SURGERY OF NEW YORK

The class of 1923 of the College of Dental and Oral Surgery of New York will celebrate its tenth anniversary with a dinner at the Fraternity Club's Bldg., New York City, May 25, at 7 p. m. Members are asked to forward their addresses to

SIDNEY E. RIESNER,
120 E. 39th St.,
New York City

SIGMA EPSILON DELTA NEW YORK GRADUATE CHAPTER

The Sigma Epsilon Delta Fraternity will honor the founders of the fraternity at a dinner to be held at the Hotel Waldorf Astoria, May 17.

IRVING SALMAN, *Scribe,*
57 W. 57th St.,
New York City

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FOR SALE—Transactions of the American Dental Association for the years 1912, 1913, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, and 1931, at $1.00 per copy. As there are only a few available, orders will be filled as long as they last in the order in which they are received. Address A1499, care American Dental Association, 212 E. Superior St., Chicago, Ill.

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BUR RECUTTING now at 20c per dozen—assorting in 1 dozen packages included—Testimonials on hand. The new "S" Bur (Wolfram Steel) 3 dozen $1.00. SCHEUN & CO., 850 Galt, Chicago. Established 1906.

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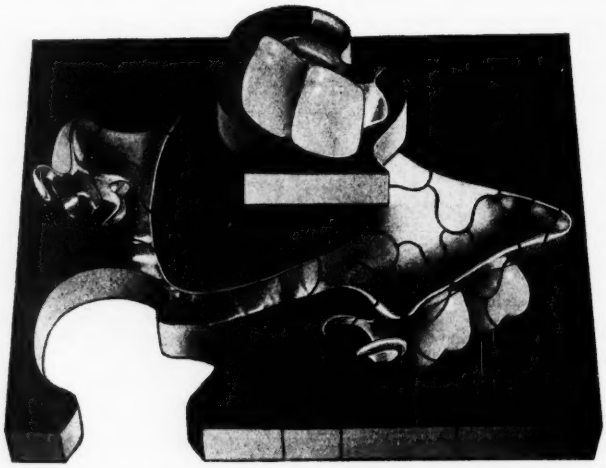

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